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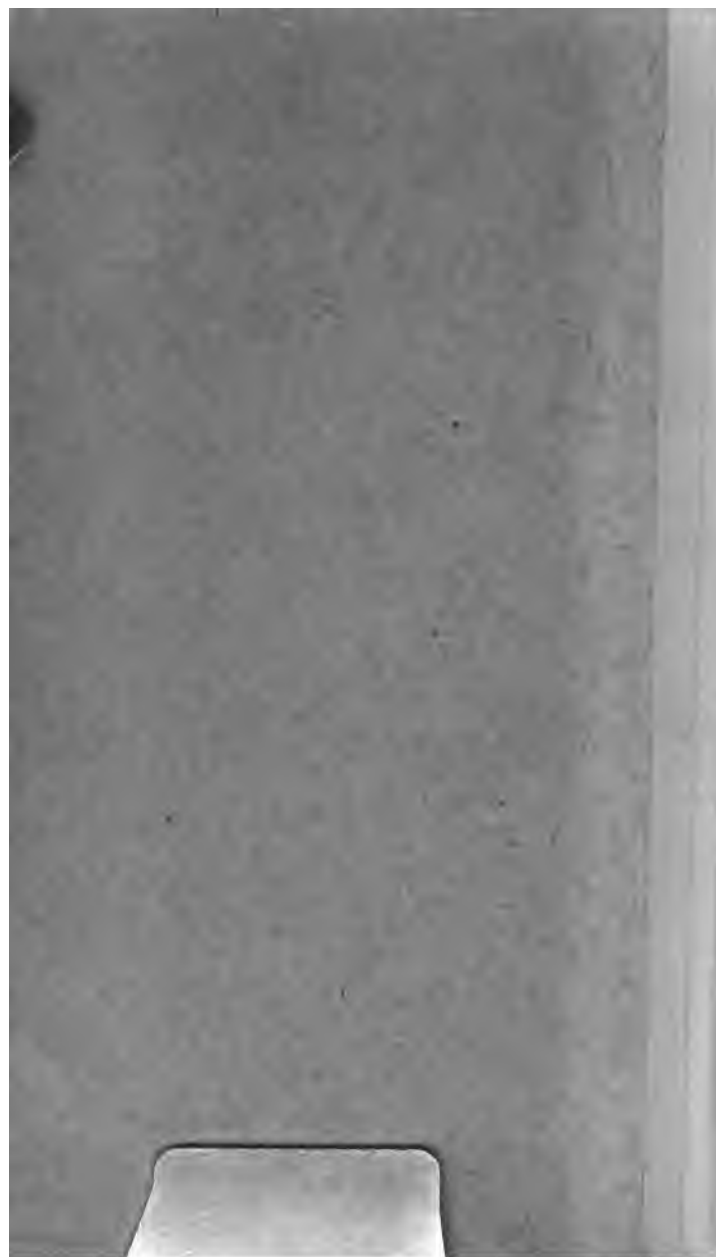
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# RUDIMENTARY ARITHMETIC

FOR THE

(1)

USE OF SCHOOLS AND SELF-INSTRUCTION.

A New Edition,

REVISED AND CORRECTED, WITH ADDITIONS AND  
NUMEROUS EXAMPLES.

BY

ABRAHAM ARMAN,

SCHOOLMASTER OF THURLEIGH, BEDS.

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*N.B.—A Key to the above, with Answers to all the questions and Solution  
in all the sums likely to present any difficulty, can be had  
separately.*

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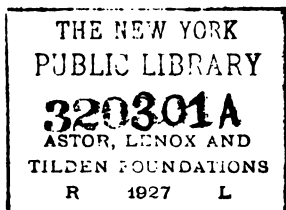
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## PREFACE.

It is hoped that the title of this little work will briefly explain the views of the *Compiler*, who, from his own experience in the business of education, has long been convinced that among the many very excellent introductory books to the science of Arithmetic few are adapted to the occasions of common life :\* some are too abstruse for novices, whilst others are defective in such examples as point out the application of the several rules to transactions of real business.

To remedy these defects, this work is divided into three sections, each section forming of itself a manual of Arithmetic ; so that the pupil, after having thoroughly learned the first section, may enter upon the subject of the second or third, according as it may be desirable for the future prospects he has in view.

A large portion of this work is devoted to the early rules, with illustrations in every rule, interspersed with numerous questions (which the pupil is recommended to make himself thoroughly master of). It is desired to convey much useful information, and be found not only interesting, but applicable to the progressive stages of life.

The several rules throughout the work are explained (it is hoped) in a clear and comprehensive manner, with many examples given at length, and to these the pupil is recommended to pay particular attention.

No answers are given in the work to any of the questions, but a Key to the whole has been prepared by the Compiler for the assistance of schoolmasters and others, containing solutions to all the questions likely to present any difficulties, and answers in short to the whole of them.

In order to facilitate and encourage frequent self-examination, numerous questions are introduced throughout the whole of the work, which the student is recommended to solve before he proceeds to the consideration of the next succeeding subjects. It will also be advantageous to him from time to time to apply himself to the promiscuous exercises at the end of each section, as a test of the soundness of his progress, and knowledge of the subjects he has before been working upon.

A. A.

\* We except one, which is No. 84 of the Series. This is made not only very instructive, but very interesting to the student of more advanced intellect.

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# ARITHMETIC.

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## SECTION I.

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### DEFINITIONS.

**ARITHMETIC** is the Science of computing by Numbers.

**Number** is either an unit, or a collection of units ; as one man, ten men.

**Numbers** are expressed by ten written characters called figures or digits, viz., 1, 2, 3, 4, 5, 6, 7, 8, 9, which are significant figures, all declaring their own values by the names ; and the cipher or nought (0) an insignificant figure, indicating no value when it stands alone.

**An integer, or whole number,** is any whole quantity or number : as a pound, three oranges, seven yards, &c.

**A prime number** is that which cannot be divided by any number excepting itself or an unit, without a remainder, as three, seven, eleven, &c.

**A composite number** is that which may be produced by multiplying two or more numbers together ; as four, fifteen, twenty-two, &c.

**The numbers** which are multiplied together to produce a composite number are called its factors or component parts.

### NOTATION AND NUMERATION.

**The expression of number by characters** is called Notation, the reading of these, Numeration. Notation, therefore, and

numeration, bear the same relation to each other, as writing and reading, and, though often confounded, they are in reality perfectly distinct.

The characters used for this purpose, are 1, one ; 2, two ; 3, three ; 4, four ; 5, five ; 6, six ; 7, seven ; 8, eight ; 9, nine ; 0, cipher or nought.

These figures have various values, depending upon their situation as in the following table, which must be read first from right to left, and then from left to right.

&c.	Hundreds of Millions.	Tens of Millions.	Millions.	Hundreds of Thousands.	Tens of Thousands.	Thousands.	Hundreds.	Tens.	Units.
	9	8	7	6	5	4	3	2	1
	9	8	9	7	6	5	4	3	2
				8	7	6	5	4	3
				9	8	7	6	5	4
					9	8	7	6	5
						9	8	7	6
							9	8	7
								9	8
									9

The uppermost line is nine hundred and eighty-seven millions, six hundred and fifty-four thousand, three hundred and twenty-one.

The third line is nine millions, eight hundred and seventy-six thousand, five hundred and forty-three.

The sixth line nine thousand, eight hundred and seventy-six.

The seventh line nine hundred and eighty-seven.

90035 is Ninety thousand and thirty-five.

90305 is Ninety thousand three hundred and five.

8070 is Eight thousand and seventy.

8700 is Eight thousand and seven hundred.

#### EXERCISES IN NUMERATION.

Write the following numbers in words :—

(1) 10. 11. 14. 19. 20. 42. 18.

(2) 200. 420. 607. 986. 473. 365.

(3) 4000. 2700. 8601. 7036.

- (4) 1060. 9111. 3333. 4569. 8765.  
 (5) 26012. 70101. 42100. 36000.  
 (6) 56761. 84562. 98761. 59763.  
 (7) 740000. 706010. 800000.  
 (8) 965436. 876973. 346781.  
 (9) 9000000. 9060401. 8706441.  
 (10) 9653286. 6563291. 9876541.  
 (11) 87506420. 60105000. 68765432.  
 (12) 34587628. 6854261.

## EXERCISES IN NOTATION.

Write the following numbers in figures :—

1. Six, seven, eight, nine, five, three, ten, twelve.
2. Twenty-six, forty-three, fifty-nine, seventy, eighty-four.
3. One hundred, one hundred and four, two hundred and forty-four, six hundred and ninety-one, seven hundred and fifty-seven, nine hundred and nine, eight hundred and twenty.
4. Four thousand, four thousand two hundred, five thousand three hundred and fifty-two, six thousand seven hundred and five, seven thousand and fifty, six thousand seven hundred and seven.
5. Four hundred thousand, five hundred thousand and forty, seven hundred thousand seven hundred and seven, two hundred and fifty-six thousand nine hundred and seventy-five, nine hundred and sixty-four thousand two hundred and fifty-nine.
6. Six millions, five millions four thousand and ninety-three, four millions six hundred and forty-five thousand one hundred and twelve, one million twenty-five thousand four hundred and sixteen.

## SIGNS USED IN ARITHMETIC.

- + named plus, signifies Addition, as  $4 + 2$  equals 6.  
 — named minus, signifies Subtraction, as  $5 - 2$  equals 3.  
 $\times$  multiplied by, signifies Multiplication, as  $4 \times 2$  equals 8.  
 $\div$  divided by, signifies Division, as  $10 \div 2$  equal 5.  
 $=$  equal to, signifies Equality, as  $2 + 4 = 6$ .  
 $:$  is to } signifies Proportion, as  $1 : 2 :: 3 : 6$   
 $::$  so is } These figures are thus read: as 1 is to 2 so is  
 $:$  to } 3 to 6.  
 $\sqrt{\quad}$  marks the Square root, as  $\sqrt{4} = 2$ .  
 $\sqrt[3]{\quad}$  marks the Cube root, as  $\sqrt[3]{8} = 2$ .  
 $\frac{1}{4}$  one farthing, or one quarter of anything.

$\frac{1}{2}$  a halfpenny, or a half of anything.

$\frac{3}{4}$  three farthings, or three quarters (three-fourths) of anything.

A vinculum connects two or more terms which are to be considered as forming one term or quantity: it is signified by a line drawn over them; or by parenthesis including them thus  $4 + 7 = 11$ , or thus  $(4 + 7)$ .

### ADDITION AND SUBTRACTION TABLE.

1 and 1 are 2	2 and 1 are 3	3 and 1 are 4	4 and 1 are 5
1 " 2 " 3	2 " 2 " 4	3 " 2 " 5	4 " 2 " 6
1 " 3 " 4	2 " 3 " 5	3 " 3 " 6	4 " 3 " 7
1 " 4 " 5	2 " 4 " 6	3 " 4 " 7	4 " 4 " 8
1 " 5 " 6	2 " 5 " 7	3 " 5 " 8	4 " 5 " 9
1 " 6 " 7	2 " 6 " 8	3 " 6 " 9	4 " 6 " 10
1 " 7 " 8	2 " 7 " 9	3 " 7 " 10	4 " 7 " 11
1 " 8 " 9	2 " 8 " 10	3 " 8 " 11	4 " 8 " 12
1 " 9 " 10	2 " 9 " 11	3 " 9 " 12	4 " 9 " 13
1 " 10 " 11	2 " 10 " 12	3 " 10 " 13	4 " 10 " 14
1 " 11 " 12	2 " 11 " 13	3 " 11 " 14	4 " 11 " 15
1 " 12 " 13	2 " 12 " 14	3 " 12 " 15	4 " 12 " 16
5 and 1 are 6	6 and 1 are 7	7 and 1 are 8	8 and 1 are 9
5 " 2 " 7	6 " 2 " 8	7 " 2 " 9	8 " 2 " 10
5 " 3 " 8	6 " 3 " 9	7 " 3 " 10	8 " 3 " 11
5 " 4 " 9	6 " 4 " 10	7 " 4 " 11	8 " 4 " 12
5 " 5 " 10	6 " 5 " 11	7 " 5 " 12	8 " 5 " 13
5 " 6 " 11	6 " 6 " 12	7 " 6 " 13	8 " 6 " 14
5 " 7 " 12	6 " 7 " 13	7 " 7 " 14	8 " 7 " 15
5 " 8 " 13	6 " 8 " 14	7 " 8 " 15	8 " 8 " 16
5 " 9 " 14	6 " 9 " 15	7 " 9 " 16	8 " 9 " 17
5 " 10 " 15	6 " 10 " 16	7 " 10 " 17	8 " 10 " 18
5 " 11 " 16	6 " 11 " 17	7 " 11 " 18	8 " 11 " 19
5 " 12 " 17	6 " 12 " 18	7 " 12 " 19	8 " 12 " 20
9 and 1 are 10	10 and 1 are 11	11 and 1 are 12	12 and 1 are 13
9 " 2 " 11	10 " 2 " 12	11 " 2 " 13	12 " 2 " 14
9 " 3 " 12	10 " 3 " 13	11 " 3 " 14	12 " 3 " 15
9 " 4 " 13	10 " 4 " 14	11 " 4 " 15	12 " 4 " 16
9 " 5 " 14	10 " 5 " 15	11 " 5 " 16	12 " 5 " 17
9 " 6 " 15	10 " 6 " 16	11 " 6 " 17	12 " 6 " 18
9 " 7 " 16	10 " 7 " 17	11 " 7 " 18	12 " 7 " 19
9 " 8 " 17	10 " 8 " 18	11 " 8 " 19	12 " 8 " 20
9 " 9 " 18	10 " 9 " 19	11 " 9 " 20	12 " 9 " 21
9 " 10 " 19	10 " 10 " 20	11 " 10 " 21	12 " 10 " 22
9 " 11 " 20	10 " 11 " 21	11 " 11 " 22	12 " 11 " 23
9 " 12 " 21	10 " 12 " 22	11 " 12 " 23	12 " 12 " 24

# ADDITION.

By Addition we find the sum of several numbers.

The sign of addition is  $+$  plus (more); the sign of equality is  $=$  (equal to).

The sum of 3, 4, and 12, is 19, and may be expressed thus:  $3 + 4 + 12 = 19$ ; that is, 3 plus 4 plus 12 equals 19.

## RULE.

Place the numbers under each other; thus, units under units, tens under tens, hundreds under hundreds, &c. Add up the figures in the column of units; consider how many tens are contained in their sum; set down the units that remain, and carry the tens to the next column; proceed thus till the whole is finished.

## EXAMPLE.

Add together the following numbers:—

3426
91048
7004
85768
465
894
26998

---

215603 = the sum or answer.

---

The sum of the first (or right-hand) column is 43 units, which is 4 tens and 3 units; the 3 units are set down, and the 4 tens carried to the second column, whose sum is 40 tens, which is 4 hundreds, and as there are no tens over, a cipher (or nought) is set down, and the 4 hundreds carried to the third column, whose sum is 36 hundreds, which is 3 thousands and 6 hundreds; the 6 hundreds are set down, and the 3 thousands carried to the fourth column; and so on.

## METHOD OF PROOF.

Cut off the top number, add the other numbers downwards; and set their sum under the answer, then add this sum to the



top number, and if the result agree with the answer, the work is correct.

## EXAMPLES.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3	3	65	64	675	673	565
5	8	48	96	288	45	583
2	6	26	28	374	450	289
6	3	72	9	657	238	605
4	4	57	76	839	54	747
3	2	38	10	700	86	330
1	1	84	57	806	19	466
—	—	48	8	397	932	699
		37	9			

(8)	(9)	(10)	(11)	(12)	(13)
634	7545	4105	5962	63827	83543
703	6457	6309	380	63591	56280
658	3869	2800	596	97486	47967
49	4004	7636	3839	56935	5839
876	8680	5990	7943	86758	365
87	4738	8578	58	49640	4694
96	5967	3754	585	85379	88080
89	5579	9787	219	64862	9756
86	—	—	—	37001	819

(14) Add together  $742 + 64 + 8 + 341 + 804 + 60 + 642 + 790 + 806$ .

(15) Add  $4126 + 27304 + 2687 + 426 + 876846 + 746897$ .

(16) Add  $76876 + 2046 + 896874 + 6876874 + 4268 + 4276$ .

(17) How much do the following sums of money amount to, when added together,  $7966\text{L.}$ ,  $864\text{L.}$ ,  $46\text{L.}$ ,  $2048\text{L.}$ ,  $46897\text{L.}$ ?

(18) I saw four large baskets full of apples: in one of the baskets there were four hundred and ninety-four apples, in another three hundred and sixty-eight, in another nine hundred and eighty, and in another four hundred and four; how many apples were there in the four baskets?

(19) In a school which I visited lately, there were six classes: in the first there were 22 boys, in the second 19, in

the third 33, in the fourth 26, in the fifth 56, and in the sixth 48; can you tell me how many boys there were in the school?

(20) A man walked 26 miles on Monday, 34 on Tuesday, 46 on Wednesday, 37 on Thursday; on Friday, being unable to walk, he procured a horse, and rode 41 miles, and completed his journey on Saturday, having travelled that day 67 miles; how many miles did he travel during the week?

(21) A gentleman planted on his property 478 oaks, 748 beeches, 64027 firs, 409 apple trees, 1764 pear trees, 878 cherry trees, and 87 peach trees; how many trees did he plant in all?

(22) A farmer laid out on oxen 348*l.*, on horses 487*l.*, on sheep 964*l.*, on cows 189*l.*, on labouring utensils 209*l.*; how much did he lay out altogether?

(23) A grocer received for goods sold on Monday 4*l.*, on Tuesday 6*l.*, on Wednesday 10*l.*, on Thursday 9*l.*, on Friday 13*l.*, and on Saturday as much as he had received all the former days of the week; how much did he receive during the week for goods?

#### QUESTIONS TO BE ANSWERED BY THE PUPIL.

What is Arithmetic, and to how many rules may it be reduced?

What is number, and how are numbers expressed?

What is an integer or whole number?

What is a prime number?

What is a composite number, and how is it produced?

What are factors, and how are they used?

What is notation, and what is numeration?

How many figures are necessary to express tens of thousands?

What is addition, and what is the object of addition?

What are the signs of addition and equality?

What is the rule for addition?

What is the vinculum; and what are its effects on additive quantities?

How is addition proved?

What is the reason of this proof?

## SUBTRACTION.

By Subtraction we find the difference between two numbers, that is, we take a less number from a greater, and the result is called the remainder—or difference.

The sign of subtraction is called minus, signifying less, and is denoted by — .

The difference between 12 and 8 is 4, and may be expressed thus :  $12 - 8 = 4$  ; that is, 12 minus 8, equals 4.

## RULE.

Place the less number under the greater, thus : units under units, tens under tens, &c. ; begin with the units : take each figure in the lower line from the figure above it, and set down the remainder. If the lower figure be greater than the upper figure, carry one to the next lower figure, and proceed thus to the end.

EXAMPLE (1). From 7613058 Minuend.  
Take 1087593 Subtrahend.

6525465—the difference or remainder.

7613058 Proof.

EXAMPLE (2). From 53687421  
Take 21535210

3215221 Remainder.

53687421 Proof.

## EXAMPLES.

1. 3 units taken from 8 units leave 5 units ; the 5 units set down : 9 tens taken from 10 tens leave 1 ten, which added to the 5 tens above, make 6 tens ; the 6 tens are set down, and 1 hundred carried to the next lower figure, thus, 1 hundred and 5 hundreds are 6 hundreds ; 6 hundreds taken from 10 hundreds leave 4 hundreds ; the 4 hundreds are set down and 1 thousand carried to the next lower figure ; and so on.

In the column of tens we take 9 tens from 10 tens, because 9 tens cannot be taken from 5 tens ; and since the 10 tens are afterward added in the shape of 1 hundred, to the next lower

figure, we do, in effect, by this operation, add 1 hundred to both the given numbers; similarly, in the column of hundreds, we take 6 hundreds from 10 hundreds, and add the 10 hundreds, in the shape of 1 thousand, to the next lower figure, the 7 thousands: this operation, therefore, is, in reality, adding 1 thousand to both the given numbers.

In this example, 1 hundred, 1 thousand, 1 ten thousand, and 1 hundred thousand, are successively added to each of the given numbers; and the accuracy of the result depends upon the fact, that the difference of two numbers remains the same when each of them is increased by the addition of any given number.

2. No unit taken from one unit 1 unit remains,  
 1 ten taken from two tens 1 ten remains,  
 2 hundreds taken from four hundreds 2 hundreds remain,  
 5 thousands taken from 7 thousands 2 thousands remain,  
 and so on. In this example there are no numbers required to be carried to the next superior number.

Proof. Add the two lower lines—that is the difference—and the subtrahend together, and if their sum be equal to the uppermost line, or the minuend, the work is correct.

## EXAMPLES.

(1) 486957 243434 <hr/>	(2) 549678 231226 <hr/>	(3) 339458 203443 <hr/>	(4) 6305421 1001211 <hr/>
(5) 62695784 27048321 <hr/>	(6) 58493675 25628410 <hr/>	(7) 682096473 134030653 <hr/>	(8) 833679584 825758728 <hr/>
(9) 300000000 67104 <hr/>	(10) 101010101 2023032 <hr/>	(11) 214790035 890987 <hr/>	(12) 100506301 599383 <hr/>

(13) From two millions two hundred and two thousand and two, take nine hundred and ninety-six thousand and seven.

(14) What is the difference between sixty-five hundred thousand and four, and twenty-nine hundred thousand seven hundred and sixty?

(15) A friend lent me 9071£: of this sum I have repaid him back 999£; how much have I yet to pay?

(16) On a cherry-tree there were 2046 cherries: of these, 1875 were gathered; how many remained?

(17) Columbus discovered America in the year 1492; how many years is it from that time to 1862?

(18) The diameter of the sun is about 883246 miles; that of the earth about 7912; what is the difference in the diameter of the sun and earth?

(19) A person was born in the year 1779, and died in the year 1857; how many years did he live?

(20) A has five houses and B four. A's houses are severally worth 540*l.*, 685*l.*, 372*l.*, 945*l.*, and 1032*l.* B's are severally worth 407*l.*, 863*l.*, 2000*l.*, and 1500*l.*; which is the richer man, A or B and by how much?

Prove each operation.

#### QUESTIONS FOR EXAMINATION.

What is Subtraction?

What are the names of the terms used in Subtraction?

What is the sign of Subtraction?

What is the rule for Subtraction?

How is Subtraction proved, and why?

#### MULTIPLICATION.

By Multiplication we find what a number amounts to if repeated a certain number of times: it is a short method of Addition.

The number produced or obtained by multiplication is called the product.

The number multiplied is the multiplicand.

The number multiplied by is the multiplier

The multiplicand and multiplier are called factors.

The sign of multiplication is  $\times$ .

The product of 11 and 5 is 55, and may be expressed thus:  $11 \times 5 = 55$ ; that is, 11 multiplied by 5 equals 55, 11 being the multiplicand, 5 the multiplier, and 55 the product.

MULTIPLICATION TABLE.

Twice times	Three times	Four times	Five times	Six times	Seven times
1 are 2	1 are 3	1 are 4	1 are 5	1 are 6	1 are 7
2 " 4	2 " 6	2 " 8	2 " 10	2 " 12	2 " 14
3 " 6	3 " 9	3 " 12	3 " 15	3 " 18	3 " 21
4 " 8	4 " 12	4 " 16	4 " 20	4 " 24	4 " 28
5 " 10	5 " 15	5 " 20	5 " 25	5 " 30	5 " 35
6 " 12	6 " 18	6 " 24	6 " 30	6 " 36	6 " 42
7 " 14	7 " 21	7 " 28	7 " 35	7 " 42	7 " 49
8 " 16	8 " 24	8 " 32	8 " 40	8 " 48	8 " 56
9 " 18	9 " 27	9 " 36	9 " 45	9 " 54	9 " 63
10 " 20	10 " 30	10 " 40	10 " 50	10 " 60	10 " 70
11 " 22	11 " 33	11 " 44	11 " 55	11 " 66	11 " 77
12 " 24	12 " 36	12 " 48	12 " 60	12 " 72	12 " 84

Eight times	Nine times	Ten times	Eleven times	Twelve times
1 are 8	1 are 9	1 are 10	1 are 11	1 are 12
2 " 16	2 " 18	2 " 20	2 " 22	2 " 24
3 " 24	3 " 27	3 " 30	3 " 33	3 " 36
4 " 32	4 " 36	4 " 40	4 " 44	4 " 48
5 " 40	5 " 45	5 " 50	5 " 55	5 " 60
6 " 48	6 " 54	6 " 60	6 " 66	6 " 72
7 " 56	7 " 63	7 " 70	7 " 77	7 " 84
8 " 64	8 " 72	8 " 80	8 " 88	8 " 96
9 " 72	9 " 81	9 " 90	9 " 99	9 " 108
10 " 80	10 " 90	10 " 100	10 " 110	10 " 120
11 " 88	11 " 99	11 " 110	11 " 121	11 " 132
12 " 96	12 " 108	12 " 120	12 " 132	12 " 144

This table is to be learnt thus:—Twice 1 are 2, twice 2 are 4, &c. ; three times 1 are 3, three times 2 are 6, 3 times 3 are 9, &c.

When the multiplier does not exceed 12—

Multiply 65313 by 7.

RULE.

Place the multiplier under the multiplicand thus, units under units.

Then say 7 times 3 are 21 units, put down the one unit under units, carry the two tens, saying 7 times 1 are 7, and 2 carried (are 9, 9 tens); from this nothing is to be carried; then say 7 times 3 are 21

65313  
7  
457191

hundreds, put down the one under the hundreds, and carry 2; 7 times 5 are 35, and 2 carried are 37, place the 7 under thousands and carry the 3; 7 times 6 are 42, and 3 carried, are 45 thousands; 457,191 the product of 65,313 multiplied by 7.

The upper line 65313 is called the multiplicand

The middle line 7 „ the multiplier

And the lower line 457191 „ the product.

## EXERCISES.

(1) 57862483 × 2	(11) 4629607 × 7
(2) 19476392 × 2	(12) 549875340 × 7
(3) 59248360 × 3	(13) 75610098 × 8
(4) 27199016 × 3	(14) 432690488 × 8
(5) 39674852 × 4	(15) 358617392 × 9
(6) 23179540 × 4	(16) 6402739 × 9
(7) 4236918 × 5	(17) 36285947 × 11
(8) 17878565 × 5	(18) 4790378 × 11
(9) 93748562 × 6	(19) 560972584 × 12
(10) 13919540 × 6	(20) 2899364 × 12

When the multiplier is a composite number, neither of whose factors exceeds 12, multiply first by one of these factors, and then the product thus obtained by the other.

Multiply 436 by 32.

## RULE.

The multiplier, viz. 32, is formed by the two factors 4 and 8; therefore, instead of multiplying by 32 you may multiply by 4 and obtain the product 1744; multiply this product by the other factor 8, and you obtain 13952, the product of the 436 multiplied by 32.

*Proof.*—Make the factors or multipliers change places, and multiply again.

## EXERCISES.

(21) 426478 × 16	(25) 643067 × 36	(29) 784978 × 72
(22) 743687 × 18	(26) 426456 × 49	(30) 204074 × 108
(23) 968748 × 24	(27) 368745 × 54	(31) 436876 × 132
(24) 674867 × 27	(28) 246876 × 56	(32) 496876 × 144

When the multiplier exceeds 12 and is a prime number—

RULE.

Place the multiplier under the multiplicand; thus, units under units, tens under tens, hundreds under hundreds, &c.

Multiply  $423 \times 142$ .

Multiply each figure of the multiplicand, beginning with the units, by the right hand or unit figure of the multiplier; set the first figure of the product under the figure multiplied by, and carry as in Addition.

$$\begin{array}{r}
 423 \text{ multiplicand.} \\
 142 \text{ multiplier.} \\
 \hline
 846 \\
 1692 \\
 423 \\
 \hline
 60066 \text{ product.}
 \end{array}$$

Proceed in a similar manner with the other figures of the multiplier.

Add the several products together.

3 units multiplied by 2 units are equal to 6 units; the 6 units are set down in the units place; 2 tens multiplied by 2 units are equal to 4 tens; the 4 tens are set down in the tens place; 4 hundreds multiplied by 2 units are equal to 8 hundreds; the 8 hundreds are set down in the hundreds place; the first product is 846 units.

3 units  $\times$  4 tens = 12 tens or 1 hundred and 2 tens, the 2 tens are set down in the tens place and the 1 hundred carried on; 2 tens  $\times$  4 tens = 8 hundreds, which, together with the 1 hundred carried, make 9 hundreds; the 9 is set down in the hundreds place; 4 hundreds  $\times$  4 tens = 16 thousands, or 1 ten thousand and 6 thousands; the 6 is set down in the thousands place, and the 1 in the tens of thousands place; the second product is 1692 tens.

3 units  $\times$  by 1 hundred = 3 hundreds, the 3 hundreds are set down in the hundreds place; 2 tens  $\times$  1 hundred = 2 thousands, the 2 thousands are set down in the thousands place; 4 hundreds  $\times$  1 hundred = 4 tens of thousands; the 4 is set down in the tens of thousands place: the third product is 423 hundreds.

The three products being added together, their sum is 60066, which is the product of 423 and 142.

When there are ciphers at the right hand of either or both of the given numbers, write them down on the right hand of the answer.

When there are ciphers in any other part of the multiplier neglect them.

To multiply by 10, 100, 1000, &c., attach as many ciphers



to the right of the multiplicand, as there are in the multiplier, thus,  $365 \times 10 = 3650$ ;  $365 \times 100 = 36500$ ;  $365 \times 1000 = 365000$ .

*Proof.*—Make the multiplicand the multiplier, and the multiplier the multiplicand, and multiply again.

## EXERCISES.

(33)  $5237468 \times 17$   
 (34)  $3592406 \times 19$   
 (35)  $73560483 \times 39$   
 (36)  $9795241 \times 167$   
 (37)  $2369570 \times 365$   
 (38)  $4793530 \times 508$

(39)  $293567 \times 2436$   
 (40)  $596000 \times 4800$   
 (41)  $796528 \times 6009$   
 (42)  $189736 \times 7854$   
 (43)  $648557 \times 3045$   
 (44)  $586470 \times 9612$

(45) A man earns 136 pounds in one year; how many pounds does he earn in 20 years? Do this in two ways.

(46) The crew of a frigate consists of 847 men, and each man receives 3*l*. a month; how much is paid to the whole crew in 12 months? Do this in two ways.

(47) If a furnace consumes 12 tons of coal in a week, how many tons does it consume in 3 years, each year being 52 weeks? Do this in two ways.

(48) A gentleman dying, gave orders in his will that his fortune should be equally divided among his five children: each received 648*l*.; how much money did he leave?

(49) There were 27 desks to be made for the school, and each desk required 29 nails; how many nails were required for all the desks?

(50) In a school there were six windows in the boys' room, and four in the girls' room: in each window there were eight panes of glass; how many panes of glass were there in all?

(51) I knew two boys: one of them was lazy and lay in bed till nine, the other was an active little fellow, who rose every morning at six; how many hours did the active boy gain in a year that the other lost?

(52) How often does a clock strike in a year at the rate of 156 times a day?

(53) How many pins may a boy point in 6 days who works 8 hours a day, and points 16,000 pins in an hour?

(54) How many miles will a person travel in 34 years, supposing he travels 9 miles per day, and there are 365 days in the year?

## QUESTIONS.

What is the object of Multiplication ?

What do you call the number produced by Multiplication ?

What are factors ?

What is the rule for Multiplication when the multiplier exceeds 12 ?

What are the rules when the multiplicand, multiplier, or both contain ciphers ?

How do we multiply by a composite number ?

How is Multiplication proved ?

State which of the following numbers are prime, and which are composite numbers, and of the composite ones name the component parts, 7, 16, 22, 23, 54, 61, 73, 108.

## DIVISION.

By Division we find how many times one number is contained in another ; it is a short method of Subtraction.

Division is in two parts—Short and Long. Short Division is when the divisor does not exceed 12 ; or, when the divisor is a composite number. Long Division is when the divisor exceeds 12 and is not a composite number.

The number to be divided is called the dividend.

The number we divide by is the divisor.

The number resulting from Division is called the quotient.

The remainder, or accidental number, is what remains when the work is completed. The sign of division is  $\div$ .

The quotient resulting from the division of 20 by 5 is 4, and may be thus expressed,  $20 \div 5 = 4$ , or  $\frac{20}{5} = 4$ , that is 20 divided by 5 equals 4 ; 20 being the dividend, 5 the divisor, and 4 the quotient.

When the divisor does not exceed 12.

## RULE.

Place the divisor on the left of the dividend, with a curve between them.

Divide each figure of the dividend, beginning at the left, by the divisor and set down the quotient under the dividend.

If when dividing any number there be a remainder, carry it as so many tens to the next figure of the dividend, continue the division, and set down the quotient as before.

## EXAMPLE.

Divide 6749 by 5.

Divisor 5)6749 dividend.

1349 $\frac{4}{5}$  quotient.

The operation is practically performed thus: fives in six once and 1 over, set down 1 and carry 1; fives in 17, three times and 2 over, set down 3 and carry 2; fives in 24, four times and 4 over, set down 4 and carry 4; fives in 49, nine times and 4 over, set down 9. The remainder 4 placed over the divisor forms the fraction four-fifths.

The 5 is contained in 6749 a thousand times, and there is 1749 over.

The 5 is contained in 1749 3 hundred times, and there is 249 over.

The 5 is contained in 249 40 times, and there is 49 over.

The 5 is contained in 49 9 times, and there is 4 over.

Hence the 5 is contained altogether in 6749, 1 thousand 3 hundred forty and nine and four-fifths times.

*Proof.*—Multiply the divisor and quotient together, 1349 $\frac{4}{5}$  adding the remainder (if any), and the product will be 5 the same as the dividend, thus—

6749

When the divisor has ciphers on the right hand, and the significant figures on the left hand do not exceed 12, cut off the ciphers, and the same number of figures from the right of the dividend.

## EXERCISES.

- |                          |                            |
|--------------------------|----------------------------|
| (1) Divide 65318944 by 2 | (11) Divide 330068886 by 7 |
| (2) " 95907368 ÷ 2       | (12) " 946821692 ÷ 7       |
| (3) " 75821841 ÷ 3       | (13) " 3782921 ÷ 8         |
| (4) " 79474614 ÷ 3       | (14) " 7798904 ÷ 8         |
| (5) " 86789536 ÷ 4       | (15) " 39308335 ÷ 9        |
| (6) " 18617419 ÷ 4       | (16) " 52528253 ÷ 9        |
| (7) " 487531900 ÷ 5      | (17) " 6931045 ÷ 11        |
| (8) " 818702633 ÷ 5      | (18) " 51538931 ÷ 11       |
| (9) " 221112240 ÷ 6      | (19) " 821964900 ÷ 12      |
| (10) " 809521429 ÷ 6     | (20) " 88783543 ÷ 12       |

When the divisor exceeds 12, and is a composite number—  
Divide 6789 by 28.

## RULE.

The two factors that produce 28 are 4 and 7 (or 7 and 4): divide them by 4  $\left\{ \begin{array}{l} 4 \ 6789 \\ 7 \ 1697 \end{array} \right.$  remains 1  
and by 7 as in the example, the quotient found is 242, but with two remainders, viz., 3 and 1. To obtain the complete or true remainder multiply the first divisor, viz., 4, by the last remainder, viz., 3, and to the product add the first remainder, 1; thus  $4 \times 3 + 1 = 13$  (see above) the true remainder.

*Proof.*—By Multiplication, as before directed; or make the factors change places, and if the operation produces the same result the work is correct.

## EXERCISES.

(21) $426478 \div 16$	(25) $643067 \div 36$	(29) $784978 \div 72$
(22) $743687 \div 18$	(26) $426456 \div 49$	(30) $204076 \div 108$
(23) $968748 \div 24$	(27) $368745 \div 54$	(31) $436876 \div 132$
(24) $674867 \div 27$	(28) $246876 \div 56$	(32) $496876 \div 144$

When the divisor contains several digits—

Divide 431769 by 528.

## RULE.

Put down the sum in the form here shown. Consider whether the divisor, viz. 528, is contained in the first three digits of the dividend, viz., 431; you see at once that it is not; mark off, then, four digits, viz. 4317. You are now to find how often 528 is contained in 4317; for this purpose find how often the first digit of the divisor, viz. 5, is contained in the first two digits of the dividend, viz. 43: it is contained 8 times; put the 8 on the opposite side of the dividend from the divisor. Multiply 528 by 8, and put the product under the 4317; subtract, and there remains 93; bring to this the next digit of the dividend, viz. 6. You are now to find how often the divisor, 528, is contained in your new dividend 936; find, as you did before, how often the first digit of

Divisor.	Dividend.	Quotient.
528	431769	(8)17
	4224	
	936	
	528	
	4089	
	3696	
	393	remainder.

the divisor 5 is contained in the first digit of the dividend 9. It is contained once; put the 1 beside the 8; multiply 528 by 1, and place the product under the 936; subtract, and you obtain 408; bring to this the next digit of the dividend, 9; find, as before, how often 528 is contained in 4089. Because 5 is contained 8 times in 40, you will be inclined to try 8. Do it, and you will find that you obtain the product 4224, but this is greater than the 4089 from which you have to subtract it; when this is the case you must try a smaller figure—in this case take 7.

*Proof.*—Multiply the quotient by the divisor, or the divisor by the quotient, adding the remainder to the product, and if the work has been correctly performed, the result will be the same as the dividend.

## EXERCISES.

$$\begin{array}{l} (33) \quad 842786 \div 78 \\ (34) \quad 976842 \div 946 \\ (35) \quad 6416879 \div 648 \\ (36) \quad 2876407 \div 4107 \end{array}$$

$$\begin{array}{l} (37) \quad 7198641 \div 2864 \\ (38) \quad 2480708 \div 2600 \\ (39) \quad 4020264 \div 9600 \\ (40) \quad 9687600 \div 4300 \end{array}$$

(41) 1200 workmen receive altogether 842,400*l.*: if this sum be equally divided between them, how much will each man receive?

(42) A gentleman leaves by will thirty thousand pounds, thus: to his widow one-third, and the remainder equally between his four children; how much will each receive?

(43) Divide a legacy of 8526*l.* between 294 persons.

(44) Divide 340480 ounces of bread between 1792 persons.

(45) What is the ninth of 6037*l.*?

(46) If a vessel contains 648 gallons of water, how long will it take to discharge it all at the rate of 18 gallons an hour?

(47) The rays of light come from the sun to the earth in  $8\frac{1}{4}$  minutes or 495 seconds; at what rate does light move per second, the distance from the sun to the earth being 95,173,000 miles?

(48) The circumference of the earth is about 25,000 miles; how many days would a man take to walk round it at the rate of 27 miles per day?

## QUESTIONS.

What is Division?

What are the dividend, divisor, quotient and remainder?

What is the sign of Division?

What is the rule when the divisor does not exceed 12?

How is Division proved?

What is done with the remainder?

How is Division performed when the divisor is a composite number?

What effect is produced upon a number by multiplying it by 2 and then dividing the product by 10?

What effect is produced upon the quotient by previously dividing both divisor and dividend by the same number?

## TABLE OF ENGLISH MONEY.

4 farthings	=	1 penny
12 pence	=	1 shilling
20 shillings	=	1 pound
21 shillings	=	1 guinea
5 shillings	=	1 crown
2 shill. & 6 pence	=	half-a-crown
2 shillings	=	a florin.

£ denotes pounds.    s. shillings.    d. pence.

## PENCE TABLE.

d.	s.	d.
20	are	1 8
24	"	2 0
30	"	2 6
36	"	3 0
40	"	3 4
48	"	4 0
50	"	4 2
60	"	5 0
70	"	5 10
72	"	6 0
80	"	6 8
84	"	7 0
90	"	7 6
96	"	8 0
100	"	8 4
108	"	9 2
120	"	10 0

## SHILLINGS TABLE.

s.	£	s.
20	are	1 0
30	"	1 10
40	"	2 0
50	"	2 10
60	"	3 0
70	"	3 10
80	"	4 0
90	"	4 10
100	"	5 0
110	"	5 10
120	"	6 0
130	"	6 10
140	"	7 0
150	"	7 10
160	"	8 0
170	"	8 10
180	"	9 0

## TROY, OR GOLDSMITH'S WEIGHT.

4 grains (gr.)	=	1 carat.
24 grains	=	1 pennyweight (dwt.)
20 dwts.	=	1 ounce (oz.)
12 ounces	=	1 pound (lb.)

By this weight gold, silver, and precious stones are weighed.

## WEIGHTS AND MEASURES.

## AVOIRDUPOIS WEIGHT.

16 drams (dr.) make 1 ounce (oz.)

16 ounces „ 1 pound (lb.)

14 pounds „ 1 stone (st.)

28 pounds, or 2 stones „ 1 quarter (qr.)

4 quarters, or 8 stone, or 112 lbs. „ 1 hundred (cwt)

20 cwt. „ 1 ton.

By this weight all coarse and heavy goods are weighed,  
all metals, except gold and silver.

## APOTHECARIES' WEIGHT.

20 grains (gr.) make 1 scruple (ð)

3 scruples „ 1 dram (ʒ)

8 drams „ 1 ounce (ʒ)

12 ounces „ 1 pound (lb.)

By this weight apothecaries compound their medicines ;  
they buy drugs by avoirdupois weight.

## LONG MEASURE.

3 barleycorns make 1 inch

12 inches „ 1 foot

3 feet „ 1 yard

6 feet „ 1 fathom

5½ yards „ 1 pole or perch

40, poles, or 220 yds. „ 1 furlong.

8 furlongs, or 1760 yds., }  
or 5280 feet } „ 1 mile

3 miles „ 1 league

60 geographical, or 69½ }  
statute miles } „ 1 degree

4 inches „ 1 hand

7<sup>9</sup>/<sub>16</sub> inches „ 1 link

100 links „ 1 chain

80 chains „ 1 mile.

## SQUARE OR SUPERFICIAL MEASURE.

144 square inches make 1 square foot

9 square feet „ 1 square yard

30½ square yards „ 1 square pole or perch

40 square yards „ 1 rood

4 roods, or 4840 sq. yards, }  
or 10 square chains } „ 1 statute acre

640 acres 1 square mile.

N.B.—The square of any number is obtained by multiplying it by itself, thus :  $12 \times 12 = 144$ , the square of 12.

## CUBIC OR SOLID MEASURE.

1728 cubic inches	make	1 cubic foot
27 cubic feet	„	1 cubic yard
40 cubic feet of rough, or 50 cubic feet of hewn timber	}	„ 1 load
42 cubic feet	„	1 ton of shipping
277·224 cubic inches	„	1 imperial gallon.

A cube is a solid figure, similar to dice, and has six equal faces; the cube of any number is obtained by multiplying it by itself, thus :  $12 \times 12 \times 12 = 1728$ , the cube of 12.

## LIQUID MEASURE.

4 gills	make	1 pint
2 pints	„	1 quart
4 quarts	„	1 gallon
9 gallons	„	1 firkin of beer
10 gallons	„	1 anker of spirits
18 gallons	„	1 kilderkin
32 gallons	„	1 barrel of ale
36 gallons	„	1 barrel of beer
42 gallons	„	1 tierce of wine
54 gallons	„	1 hogshead of beer
63 gallons	„	1 hogshead of wine
2 hogsheads	„	1 pipe of wine
2 pipes	„	1 tun

In some parts of England 2 gills = 1 pint.

## DRY MEASURE.

4 gills	make	1 pint
2 pints	„	1 quart
2 quarts	„	1 pottle
4 quarts	„	1 gallon
2 gallons	„	1 peck
4 pecks	„	1 bushel
4 bushels	„	1 coomb
8 bushels	„	1 quarter
5 quarters	„	1 wey
2 weys	„	1 last

In some places corn is sold by the load of 5 bushels.



## CLOTH MEASURE.

2½ inches	make	1 nail
4 nails	„	1 quarter of a yard
3 quarters	„	1 Flemish ell
4 quarters	„	1 yard
3 quarters	„	1 English ell
6 quarters	„	1 French ell.

## TIME.

60 thirds	make	1 second
60 seconds	„	1 minute
60 minutes	„	1 hour
24 hours	„	1 day
7 days	„	1 week.
4 weeks	„	1 month (lunar)
12 calendar months, or 13 common months, 1 day 6 hours, or 365 days 6 hours	} 1 year.	

Any year of Our Lord, within the present century, divided by 4, without remainder, is Leap Year (which contains 366). If there be a remainder, it shows the number of year Leap Year; thus, the year 1861, divided by 4, gives remainder 1; hence it is the year after Leap Year.

## ANGULAR MEASURE.

60 thirds (″″)	=	1 second (″)
60 (″)	=	1 minute (′)
60 (′)	=	1 degree (°)
30 (°)	=	1 sign of Zodiac
90 (°)	=	1 quadrant
12 signs or 360°	=	1 great circle.

## COAL MEASURE.

4 pecks	make	1 bushel
3 bushels	„	1 sack
3 sacks	„	1 vat, or strike
12 sacks	„	1 chaldron
21 chaldrons	„	1 score.

Coals are now sold by weight—140 pounds; or 2 bushels make one bag; 16 bags, or 32 bushels, one ton = 20 c

## WOOL WEIGHT.

7 pounds	make	1 clove
2 cloves	„	1 stone
2 stones	„	1 tod
$6\frac{1}{2}$ tods	„	1 wey
2 weys	„	1 sack
12 sacks	„	1 last
240 pounds	„	1 pack.

## HAY AND STRAW WEIGHT.

36 pounds	make	1 truss of straw
56 pounds	„	1 truss of old hay
60 pounds	„	1 truss of new hay
36 trusses	„	1 load.

The standard for gold coin in England is 22 parts of pure gold and 2 parts of copper; for silver coin, 37 parts of pure silver, and 3 parts copper.

One pound troy of gold is coined into  $46\frac{2}{3}$  sovereigns.

One pound troy of silver is coined into 66 shillings.

One pound avoirdupois of copper is coined into 24 pence.

The Mint price of standard gold is 3*l.* 17*s.* 10½*d.* per ounce, and of silver 5*s.* 6*d.* per ounce.

177 lbs. troy = 144 lbs. avoirdupois

1 lb. troy = 1 lb. apothecaries'

Land is measured by a chain 4 poles or 22 yards long.

A piece of ground 10 chains long and 1 chain broad = 1 acre.

Painting, glazing, roofing, plastering, &c., are measured by square measure.

A square inch is a square 1 inch long and 1 inch broad.

A square foot is 12 inches long and 12 inches broad.

A cubic inch is a solid body having six equal sides, each side being one square inch.

Stone, timber, and all solids are measured by cubic measure.

One cubic inch of water weighs 252.458 grains.

12 articles	make	1 dozen
20 articles	„	1 score
12 dozen	„	1 gross
24 sheets of paper	„	1 quire
20 quires	„	1 ream.

## COMPOUND ADDITION.

## RULE.

Place the numbers so that those of the same name stand under each other, viz. : pounds under pounds, shillings under shillings, pence under pence, &c., and draw a line under all.

Add up the numbers in the lowest term, and find, by division, how many units of the next higher term are contained in their sum.

Set down the remainder, and carry the quotient to the next higher term. Proceed thus to the end.

## EXAMPLE.

Add together 41*l.* 14*s.* 6½*d.*, 280*l.* 12*s.* 4¾*d.*, 648*l.* 0*s.* 10½*d.*, 67*l.* 18*s.* 5*d.*, 1*l.* 13*s.* 0½*d.*, and 18*s.* 11½*d.*

<i>£</i>	<i>s.</i>	<i>d.</i>
41	14	6½
280	12	4¾
648	0	10½
67	18	5
1	13	0½
0	18	11½
1040	18	2½ = sum or answer.
999	8	8½
1040	18	2½ proof.

The sum of the column of farthings is 10 farthings, which is 2 pence and 2 farthings; the 2 farthings are set down, and the 2 pence carried to the column of pence, whose sum is 38 pence, which is 3 shillings and 2 pence; the 2 pence are set down, and the 3 shillings carried to the column of shillings, whose sum is 78 shillings, which is 3 pounds and 18 shillings; the 18 shillings are set down, and the 3 pounds carried to the units column of pounds; proceed now as in Simple Addition. The principles on which the operation depends are the same as for Simple Addition, only that the columns here do not differ from each other in a tenfold degree.

*Proof.*—The same process as in the Simple Addition of Numbers, which has been already explained.

EXERCISES.

(1)	(2)	(3)	(4)
£ s. d.	£ s. d.	£ s. d.	£ s. d.
76 4 6	58 14 7	75 14 7	84 3 2
57 9 9	69 15 6	67 15 9	96 4 0½
49 10 8	72 14 8	76 19 10	41 0 6
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<hr/>	<hr/>	<hr/>	<hr/>
<hr/>	<hr/>	<hr/>	<hr/>
(5)	(6)	(7)	(8)
£ s. d.	£ s. d.	£ s. d.	£ s. d.
4567 14 6	76 14 7	3767 13 11	5674 17 6½
776 15 7	667 13 6	4678 14 10	4767 16 11½
76 17 9	67 15 7	767 12 9	3466 17 10½
51 0 10	5 4 2	10 11 5	5984 2 2½
44 5 6	5 3 4	3 4 11	3762 9 9
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<hr/>	<hr/>	<hr/>	<hr/>
(9)	(10)	(11)	(12)
£ s. d.	£ s. d.	£ s. d.	£ s. d.
9767 0 6½	6767 11 6½	5764 17 6½	634 7 11½
7649 11 2½	7676 16 9½	7457 16 5	65 7 7
4767 16 10½	5948 17 8½	6743 18 0½	7 12 10½
164 1 1	5786 7 6	67 6 6½	5678 18 8
92 7 2½	6325 8 2½	432 5 9	439 0 0
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(13)			(14)			(15)			(16)		
£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
0	14	7½	5674	16	7½	5674	1	9½	4767	14	7½
677	1	0	4767	17	6½	4767	11	10½	748	18	7½
5767	2	6	1545	19	7½	78	18	11½	7674	14	6½
3697	14	7½	3246	17	6	0	19	10½	7	13	3½
5634	0	0½	4766	10	5½	5044	4	1	750	6	4
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(17)			(18)			(19)			(20)		
£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
674	11	11½	476	14	7	674	13	3½	674	17	6½
567	14	10½	576	15	6½	45	15	7½	123	12	2
476	4	11	76	17	7½	476	4	6½	567	0	7½
347	15	0½	576	11	8	577	16	0½	579	18	9½
476	13	9½	463	14	9½	578	6	3½	476	6	6½
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(21)			(22)			(23)			(24)		
£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
576	4	7½	549	4	6½	876	0	3	219	0	5
7	7	6	7	19	9½	0	5	0	32	11	8½
732	19	0½	0	16	6½	56	11	11	0	0	0½
567	0	9½	734	19	9½	123	5	2½	127	8	2
754	2	6½	566	14	4½	12	0	0	29	6	5½
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## TROY WEIGHT.

(25)			(26)			(27)			(28)		
lb.	oz.	dwt. gra.	lb.	oz.	dwt. gra.	lb.	oz.	dwt. gra.	lb.	oz.	dwt. gra.
7	0	5 9	5	9	7 0	88	7	9 8	5	9	8 0
5	6	6 7	0	0	6 7	80	9	8 6	3	2	16 16
9	5	6 8	8	7	6 4	0	8	7 5	4	6	17 0
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# COMPOUND ADDITION.

27

(29)				(30)				(31)			
lb.	oz.	dwt.	grs.	lb.	oz.	dwt.	grs.	lb.	oz.	dwt.	grs.
55	9	12	14	87	3	7	12	57	10	14	11
67	9	11	11	0	11	12	3	0	0	11	10
66	8	10	5	0	0	16	14	46	9	9	8
74	6	5	3	44	12	10	13	22	8	7	5
12	3	5	4	67	8	9	10	11	10	13	14
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# AVOIRDUPOIS WEIGHT.

(32)				(33)				(34)				(35)			
cwt.	qrs.	lb.		cwt.	qrs.	lb.		cwt.	qrs.	lb.		cwt.	qrs.	lb.	
76	3	14		44	1	16		14	3	17		56	3	14	
87	2	15		56	3	11		37	1	16		57	1	17	
14	1	11		47	1	16		47	2	27		58	2	26	
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(36)				(37)				(38)				(39)			
cwt.	qrs.	lb.		cwt.	qrs.	lb.		cwt.	qrs.	lb.		cwt.	qrs.	lb.	
76	1	19		88	2	17		476	3	15		576	2	19	
65	3	13		59	2	20		764	1	7		7	1	20	
47	2	17		0	3	0		6	3	14		64	3	2	
81	2	18		67	1	15		0	1	18		787	1	11	
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(40)				(41)				(42)				(43)			
cwt.	qrs.	lb.	oz.	cwt.	qrs.	lb.	oz.	cwt.	qrs.	lb.	oz.	cwt.	qrs.	lb.	oz.
767	1	16	0	476	1	24	8	447	1	7	0	14	2	12	3
44	1	17	5	756	3	21	0	576	1	6	8	3	3	7	4
567	3	13	3	767	1	16	0	467	1	7	1	0	2	15	3
576	1	0	4	567	2	15	4	563	1	6	2	7	0	3	5
341	2	11	2	973	1	12	4	428	0	0	1	0	0	0	12
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## APOTHECARIES' WEIGHT.

(44)				(45)				(46)				(47)			
lb.	oz.	drs.	scr.	lb.	oz.	drs.	scr.	oz.	drs.	scr.	grs.	oz.	drs.	scr.	grs.
2	11	7	2	5	6	1	2	9	7	2	19	6	5	0	17
14	10	7	1	3	0	2	1	7	1	0	17	8	6	2	8
9	7	6	2	0	5	0	2	11	5	1	16	4	5	1	13
15	9	7	1	10	7	7	0	6	3	2	5	17	4	2	9
19	4	6	2	4	8	6	2	4	6	1	14	8	6	1	6
17	11	7	1	11	9	5	1	3	1	2	9	7	3	1	15
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## LONG MEASURE.

(48)			(49)			(50)			(51)		
yds.	ft.	in.	yds.	ft.	in.	mls.	fur.	p.	mls.	fur.	p.
18	2	7	16	2	11	2	7	39	14	6	35
14	1	6	7	1	9	1	6	30	20	4	16
12	2	5	12	2	6	2	3	25	38	3	27
10	1	4	0	0	7	1	2	20	51	0	18
9	2	7	8	1	0	1	1	18	32	1	5
6	0	3	7	2	3	2	7	28	17	3	11
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## SQUARE OR LAND MEASURE.

(52)			(53)			(54)			(55)		
a.	r.	p.	a.	r.	p.	yds.	ft.	in.	yds.	ft.	in.
32	3	16	46	3	27	14	6	36	15	3	86
16	2	21	12	2	16	27	8	57	19	6	47
76	1	13	61	0	34	29	7	20	26	8	136
24	2	27	46	3	17	26	5	26	23	7	115
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## CUBIC MEASURE.

(56)			(57)		
yds.	ft.	in.	yds.	ft.	in.
1	25	1720	0	25	167
0	20	1640	1	26	76
1	26	40	1	20	482
0	15	1727	0	23	20
1	19	1070	1	19	0
1	17	1063	1	25	1643
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## ALE OR BEER MEASURE.

(58)				(59)			
hds.	gals.	qt.	pt.	brl.	gals.	qts.	pts.
5	52	3	1	3	30	3	1
3	36	2	0	15	16	2	0
7	40	1	1	26	31	3	1
1	27	3	0	17	5	1	0
4	21	0	1	36	11	3	1
2	0	3	0	81	3	2	1
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WINE MEASURE.

(60)				(61)			
gal.	qts.	pts.	gls.	gal.	qts.	pts.	gls.
50	3	1	3	16	2	1	2
49	2	0	1	26	3	1	3
40	1	0	2	14	0	0	1
39	2	1	2	25	1	1	2
27	3	0	0	60	2	1	3
46	3	1	3	56	1	1	2

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CLOTH MEASURE.

(64)				(65)			
Eng.ells	qrs.	nls.	yrds.	qrs.	nls.	yrds.	nls.
4	3	2	5	3	2		
3	2	0	4	1	1		
2	4	1	2	2	0		
4	2	3	3	2	2		
3	3	2	1	3	0		
2	2	2	4	1	1		

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ANGULAR MEASURE.

(68)			(69)		
deg.	min.	sec.	deg.	min.	sec.
15	35	40	29	25	35
25	42	53	27	30	40
21	30	49	15	55	50
19	19	39	25	15	20
17	27	57	20	12	27
13	23	53	0	49	49

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DRY MEASURE.

(62)				(63)	
wey.	qr.	bush.	peck.	gall.	qt.
1	4	7	3	1	3
0	3	4	2	0	2
1	2	6	1	1	1
0	4	2	3	0	0
1	3	6	2	1	2
1	2	5	3	0	3

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TIME.

(66)				(67)	
mo.	weeks.	days.	days.	hours.	mins.
12	3	6	6	23	50
11	2	5	4	19	45
9	1	3	3	20	30
7	3	2	2	17	6
6	2	1	5	6	51
10	0	6	4	3	2

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COAL MEASURE.

(70)				(71)	
strike.	bush.	peck.	chalds.	sacks.	bush.
3	8	2	20	11	2
2	6	1	14	9	1
0	4	0	19	0	2
1	2	3	17	10	0
3	1	2	6	7	1
2	7	1	15	8	2

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WOOL WEIGHT.

(72)		
sacks.	weys.	tons.
11	1	5
9	0	6
6	1	3
2	1	4
1	0	5
10	1	6
8	0	3

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(73)		
stones.	cloves.	pounds.
19	1	5
16	0	2
13	1	6
9	0	3
17	1	1
9	1	4
13	1	1

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74. A owes to B 567*l.* 16*s.* 7½*d.*, to C 47*l.* 16*s.*, and to D 56*l.* 0*s.* 1*d.* How much does he owe in all?

75. A merchant sends off the following quantities of butter:—47 cwt. 2 qrs. 7 lb.; 38 cwt. 3 qrs. 8 lb.; and 16 cwt. 2 qrs. 20 lb. How much did he send off in all?

76. A silversmith has 7 lb. 8 oz. 16 dwts., 9 lb. 7 oz. 3 dwts., and 4 lb. 1 dwt. of silver in his possession. What is the total quantity?

77. A merchant sells to A 76 yards 3 qrs. 2 nails; to B 90 yards 3 qrs. 3 nails; and to C 190 yards 1 nail. How much has he sold in all?

78. A wine merchant receives into his stores 4 tuns 2 hogsheads; 5 tuns 3 hogsheads; and 7 tuns 1 hogshead. How much is the entire quantity?

79. A man has three farms, the first contains 120 acres 2 roods 7 perches; the second, 150 acres 3 roods 20 perches; and the third, 200 acres. How much land does he possess in all?

80. A servant has had three masters: with the first he lived 2 years and 9 months; with the second 7 years and 6 months; and with the third 4 years and 3 months. What was the servant's age on leaving his last master, supposing that he was 20 years' old on going to the first and that he went directly from one to the other?

#### QUESTIONS FOR THE PUPIL.

What is the difference between the Simple and Compound Rules?

Might the Simple Rules have been constructed so as to answer also for numbers of different denominations?

What is the rule for Compound Addition?

How is Compound Addition proved?

#### COMPOUND SUBTRACTION.

By Compound Subtraction we find the difference of two numbers consisting of different names.

##### RULE.

Place the less number under the greater, so that the parts which are of the same name may stand under each other.

Begin with the lowest name, and take each number in the lower line from the number above it, and set down the remainder.

If the number in the lower line be greater than the number above it, subtract the lower one from as many of its name as make one of the next higher, and add the remainder to the upper number; carry one to the next number in the lower line, and proceed thus to the end.

The method of proof is the same as in Subtraction of Simple Numbers.

EXAMPLE.	From	£	s.	d.
		243	13	7½
	Take	40	18	10½
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		£202	14	8½ difference
		<hr/>		
		243	13	7½ proof
		<hr/>		

The principle of this rule is the same as that of Subtraction of Simple Numbers.

## EXAMPLES.

(1)	(2)	(3)	(4)
£ s. d.	£ s. d.	£ s. d.	£ s. d.
9 5 2	1 3 4	1 5 6	3 15 1½
6 3 1	0 6 2	1 13 4½	1 12 8
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(5)	(6)	(7)	(8)
£ s. d.	£ s. d.	£ s. d.	£ s. d.
26 8 3½	321 15 0	427 4 2½	1095 15 6¼
17 6 9½	247 19 1½	159 16 7½	895 16 8½
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(9)	(10)	(11)	(12)
£ s. d.	£ s. d.	£ s. d.	£ s. d.
567 11 5½	971 0 0½	437 15 0	478 10 0
479 10 10½	0 0 7	0 11 1½	47 11 0½
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(13)	(14)	(15)	(16)
£ s. d.	£ s. d.	£ s. d.	£ s. d.
2150 18 5½	1084 11 5	6197 3 9	21569 19 1½
1949 19 1½	539 12 7	4593 8 10½	20670 18 2½
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**SECTION I.**

**TROY WEIGHT.**

(17)			(18)			(19)				(20)			
oz.	dwt.	grs.	oz.	dwt.	grs.	lb.	oz.	dwt.	grs.	lb.	oz.	dwt.	grs.
27	15	8	16	18	5	52	8	7	5	19	0	1	6
22	16	7	9	18	16	23	11	16	8	7	10	15	8
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### AVOIRDUPOIS WEIGHT.

(21)			(22)			(23)				(24)				
lb.	oz.	drs.	qrs.	lb.	oz.	drs.	cwt.	qr.	lb.	oz.	tons.	cwt.	qr.	lb.
26	11	15	3	26	11	8	16	2	13	9	5	7	1	19
23	14	9	2	19	13	12	14	3	21	11	3	16	3	25
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### APOTHECARIES' WEIGHT.

(25)			(26)					(27)				
3	3	9	1b	3	3	9	grs.	1b	3	3	9	grs.
27	1	1	7	6	1	2	16	14	5	4	1	13
14	2	2	5	7	2	1	18	11	9	6	2	18
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**'LONG MEASURE.**

(28)			(29)			(30)			(31)		
mile.	fur.	per.	fur.	per.	yd.	per.	yd.	ft.	yd.	ft.	in.
4	6	20	7	10	1	16	2	1	16	1	8
1	7	35	2	19	4	12	4	2	18	2	9
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## SQUARE OR LAND MEASURE.

(32)			(33)			(34)			(35)		
A.	R.	P.	A.	R.	P.	A.	R.	P.	A.	R.	P.
42	1	10	36	0	20	42	1	25	27	2	18
16	2	25	13	3	30	17	2	35	13	3	20
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CUBIC OR SOLID MEASURE.

(36)			(37)			(38)		
yds.	ft.	in.	yds.	ft.	in.	yds.	ft.	in.
36	19	964	46	17	872	50	10	14
22	26	1000	28	19	984	36	20	1116
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LIQUID MEASURE.

WINE.						BEER.							
(39)			(40)			(41)				(42)			
tuns.	galls.	qts.	tuns.	hhd.	galls.	bar.	gal.	qt.	pt.	gal.	qt.	pt.	gill
72	5	1	78	1	15	7	6	3	1	8	1	1	2
49	27	2	39	3	18	5	7	2	0½	3	2	0	3
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DRY MEASURE.

(43)			(44)			(45)					
qrs.	bush.	pk.	bush.	pk.	gal.	pot.	wey	qrs.	bush.	pk.	gal.
69	1	1	4	1	1	0	2	3	3	2	0
58	3	3	2	2	1	1	1	4	7	6	1
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CLOTH MEASURE.

(46)			(47)			(48)			(49)					
yds.	qrs.	nls.	Flem.	ells.	qrs.	nls.	Eng.	ells.	qrs.	nls.	Flem.	ells.	qrs.	nls.
36	2	1	6	1	2		4	3	1		5	3	2	
18	3	2	3	2	3		2	4	3		3	4	3	
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TIME.

(50)			(51)			(52)			(53)				
hrs.	ws.	days.	hrs.	ws.	days.	days.	hrs.	min.	mo.	wk.	dys.	hrs.	min.
43	4	2	32	3	1	47	12	10	11	1	3	11	20
24	6	5	16	7	6	17	20	40	8	3	5	16	46
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## ANGULAR MEASURE.

(54)			(55)				(56)				
deg.	min.	sec.	signs	.	'	"	signs	.	'	"	"
85	42	15	12	25	24	23	11	19	36	44	53
79	49	12	8	29	46	54	9	22	45	52	59
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## COAL MEASURE.

(57)			(58)		
chal.	sks.	bush.	sack.	bush.	pks.
16	10	2	9	1	2
14	11	1	7	2	3
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## WOOL WEIGHT.

(59)			(60)		
sk.	wey	tod.	stone.	clove.	lb.
11	1	5	19	1	5
9	0	4	16	0	4
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61. A shopkeeper bought a piece of cloth containing 42 yards for 22*l.* 10*s.*; of which he sells 27 yards for 15*l.* 15*s.* How many yards has he left, and what have they cost him?

62. A young man had in the Savings' Bank 124*l.* 10*s.* 6*d.* Being sick, and unable to work, he drew out 8*l.* 4*s.* 8*d.* After this he went into business, and laid out in the purchase of stock 42*l.* 16*s.* 6*d.*, and for fixtures 14*l.* 18*s.* What sum had he still in the bank?

63. A merchant has in cash 568*l.* 17*s.* 6*d.*; goods valued at 4794*l.* 18*s.*; a house worth 809*l.*; a ship worth 894*l.*; debts due to himself 749*l.* 16*s.* 9½*d.* He owes for goods 2475*l.* 16*s.*; an architect 374*l.* 19*s.*; and various other sums that come to 798*l.* 17*s.* 9½*d.* What is his net stock?

64. A merchant bought 23¼ tons 17 cwt. 1 qr. 23*lbs.* of various articles, and sold 147 tons 18 cwt. 2 qrs. 24 *lbs.* How much remained unsold?

65. If from a piece of cloth containing 496 yards 3 qrs. and 3 nails, I cut 247 yards 2 qrs. 2 nails, what is the length of the remainder?

66. A farm contains 769 acres 3 roods and 20 perches, of which 576 acres 2 roods 23 perches are tilled; how much remains untilled?

67. A merchant bought 600 salt ox-hides, weighing 581 cwt. 2 *lbs.*, of which he sold 250 hides weighing 239

cwt. 3 qrs. 25 lbs.; how many hides had he left, and what did they weigh?

68. A merchant has 209 casks of butter, weighing 400 cwt. 2 qrs. 14 lbs., and ships off 173 casks, weighing 213 cwt. 2 qrs. 27 lbs.; how many casks has he left, and what is their weight?

QUESTIONS.

What is the rule for Compound Subtraction?

How is Compound Subtraction proved?

COMPOUND MULTIPLICATION.

By Compound Multiplication we find what a number, consisting of different names, will amount to, if repeated a certain number of times.

RULE.

When the multiplier does not exceed 12, place the multiplier under the lowest term in the multiplicand, thus—

Multiply each of the terms of the multiplicand, beginning with the lowest term, by the multiplier 6. Thus, 6 times three farthings are 18; eighteen farthings = 4 pence 1 halfpenny,

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 452 \quad 11 \quad 10\frac{3}{4} \\ \hline \text{£}2715 \quad 11 \quad 4\frac{1}{2} \end{array}$$

set down the  $\frac{1}{2}$  penny and carry the 4 to the pence;  $6 \times 10 = 60$  and 4 carried are 64 pence = to 5 shillings and 4 pence, put down the 4 and carry the shillings;  $6 \times 11 = 66$  and 5 carried are 71 shillings = equal to 3*l.* 11*s.*, put down the 11 and carry the 3 to the pounds; proceed then as in Simple Multiplication.

EXERCISES.

(1)	(2)	(3)	(4)
£ s. d. 78 18 4 $\frac{1}{2}$ 5	£ s. d. 68 14 9 $\frac{1}{4}$ 6	£ s. d. 43 14 7 $\frac{1}{2}$ 7	£ s. d. 7 17 11 $\frac{1}{2}$ 8
_____	_____	_____	_____
_____	_____	_____	_____
(5)	(6)	(7)	(8)
£ s. d. 64 7 4 $\frac{1}{2}$ 2	£ s. d. 43 12 6 $\frac{1}{2}$ 3	£ s. d. 57 16 8 $\frac{1}{2}$ 4	£ s. d. 14 0 6 $\frac{1}{2}$ 9
_____	_____	_____	_____
_____	_____	_____	_____

(9)	(10)	(11)	(12)
£ s. d. 87 12 4½ 10	£ s. d. 78 16 7½ 11	£ s. d. 59 19 7½ 12	£ s. d. 67 16 10½ 9
_____	_____	_____	_____
_____	_____	_____	_____
(13)	(14)	(15)	(16)
£ s. d. 68 10 11½ 8	£ s. d. 49 18 0½ 7	£ s. d. 39 19 6½ 6	£ s. d. 1064 8 9½ 5
_____	_____	_____	_____
_____	_____	_____	_____

*Proof.*—Multiply the multiplicand by a number less by unity than the multiplier, and add the multiplicand.

£ s. d. 79 18 4½ 5
_____
399 11 9½ Ans.

Thus : to multiply 79*l.* 18*s.* 4½*d.* by 5.

And, to prove this, we multiply by 4, and add the upper most line : thus :

£ s. d. 79 18 4½ 4
_____
319 13 5 = four times the given sum.
79 18 4½ = once the given sum.
_____
399 11 9½ = five times the given sum.

In practice, it is not necessary to write the multiplicand twice, since it is just as easy to add it from above as from below the product.

### RULE

When the multiplier exceeds 12, and is a composite number, multiply successively by its factors.

*Proof.*—Make the factors change places.

Example	£ s. d. 3 7 6 2	or thus Proof.	£ s. d. 3 7 6 3	or thus Proof.	£ s. d. 3 7 6 9
	_____		_____		_____
	6 15 0		10 2 6		30 7 6
	9		6		2
	_____		_____		_____
	£60 15 0		£60 15 0		£60 15 0

No.	£	s.	d.	
(17)	4	5	6½	× 16
(18)	6	3	9	× 18
(19)	4	16	7	× 20
(20)	5	14	6½	× 22
(21)	9	11	3½	× 28
(22)	8	6	4	× 32

No.	£	s.	d.	
(23)	2	17	6	× 36
(24)	3	19	7½	× 42
(25)	3	16	7	× 56
(26)	2	3	6	× 64
(27)	3	4	7	× 81
(28)	0	9	4	× 100

The 12 preceding sums to be worked in as many different ways as the multiplier will admit of, as shown in the examples above.

When the multiplier exceeds 12, and is not a composite number.

Multiply 4*l.* 6*s.* 3*d.* by 13.

RULE.

If under 20 multiply the multiplicand by one 10, and then the multiplicand by the units remaining in the multiplier—then add the two products together for the result.

£	s.	d.
4	6	3
		10

43	2	6
12	18	9
£56	1	3

Multiply 4*l.* 6*s.* 3*d.* by 23.

Or, thus:—Multiply the multiplicand 4*l.* 6*s.* 3*d.* by 10, and the product so obtained by 2, then the top line by 3, adding the product so obtained to the other products for the result.

£	s.	d.
4	5	3
		10

43	2	6
		2
86	5	0
12	18	9
£99	3	9

When the multiplier exceeds a hundred, multiply the multiplicand by 10, and the product so obtained by 10, and proceed as before.

When the multiplier is two or more hundred, multiply the multiplicand by 10, that product again by 10—and that product by the number of hundreds, then proceed as before directed. For thousands multiply by four tens, and proceed in like manner.



## EXAMPLES.

Multiply £6 12s. 4½d. by 345.

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 6 \quad 12 \quad 4\frac{1}{2} \times 5 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 66 \quad 8 \quad 6\frac{1}{2} \times 4 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 661 \quad 15 \quad 5 \\ \hline 3 \end{array}$$

Product of 300 = 1985 6 3

" of 40 = 264 14 2

" of 5 = 33 1 9½

$$\begin{array}{r} 345 \quad \text{£}2283 \quad 2 \quad 2\frac{1}{2} \\ \hline \end{array}$$

Multiply £7 8s. 5d. by 648.

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 7 \quad 8 \quad 5 \times 8 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 74 \quad 4 \quad 2 \times 4 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 742 \quad 1 \quad 8 \\ \hline 6 \end{array}$$

Product of 600 = 4452 10 0

" of 40 = 296 16 8

" of 8 = 59 7 4

$$\begin{array}{r} 648 \quad \text{£}4808 \quad 14 \quad 0 \\ \hline \end{array}$$

## EXERCISES.

	£	s.	d.
(29) Multiply	64	16	7½ × 68
(30) "	86	18	4½ × 75
(31) "	69	12	6½ × 98
(32) "	648	19	7½ × 68
(33) "	367	16	4½ × 246
(34) "	658	13	7 × 478
(35) "	467	15	8½ × 647
(36) "	675	0	4½ × 608

	£	s.	d.
(37) Multiply	563	12	0¾ × 785
(38) "	807	14	6½ × 680
(39) "	98	13	8½ × 87
(40) "	42	16	7½ × 45
(41) "	746	0	7½ × 96
(42) "	820	7	6½ × 268
(43) "	763	16	0½ × 403
(44) "	278	9	11½ × 784

45. A gentleman spends per day 1l. 7s. 6d.; how much does he spend in a year?

46. A farmer paid in rent 246l. 16s. 6d. every year; how much did he pay his landlord in the course of 25 years?

47. An artizan received 1l. 14s. 6d. per week; what did his wages amount to in the year?

48. What is the value of 568 ounces of gold at 3l. 10s. 6d. per ounce?

49. A person spent 12s. 6d. per day, and found that at the end of the year he had saved 25 guineas; what was his annual income?

50. A farmer bought 568 sheep, and paid 1l. 12s. 6d. for each of them; how much did the whole flock cost him?

## TO MULTIPLY BY PARTS.

If the part be ¼, take a quarter of the multiplicand, if the

part be  $\frac{1}{2}$ , take one half, and if the part be  $\frac{3}{4}$ , take a half and then a quarter of the multiplicand, or multiply the multiplicand by the upper figure of the fraction and divide the product by the lower figure. Add the quotient thus obtained to the product obtained by multiplying the multiplicand by the whole number in the multiplier.

This latter way applies to any fractional part.

## EXAMPLES.

Multiply 4*l.* 4*s.* 8*d.* by  $4\frac{3}{4}$ *d.*

£	s.	d.		£	s.	d.
4	4	8		4	4	8
		4	or thus			3
<hr/>				<hr/>		
16	18	8		4	12	14 0
2	2	4	= half of top line	3	3	6 = $\frac{3}{4}$ of multiplicand
1	1	2	= quarter of do.	16	18	8. product of 4 <i>l.</i> 4 <i>s.</i> 8 <i>d.</i> ×
<hr/>				<hr/>		
£20	2	2		£20	2	2
<hr/>				<hr/>		

## EXERCISES.

	£	s.	d.		£	s.	d.
(51) Multiply	4	2	6	by	$4\frac{1}{2}$		
(52) "	7	16	7	×	$7\frac{1}{2}$		
(53) "	28	19	$8\frac{1}{2}$	×	$9\frac{1}{4}$		
(54) "	87	13	$9\frac{1}{2}$	×	$12\frac{1}{2}$		
(55) "	874	12	$10\frac{1}{4}$	×	$10\frac{1}{4}$		
(56) "	478	14	$6\frac{1}{2}$	×	$11\frac{1}{2}$		
(57) Multiply	7	8	9	×	$7\frac{1}{4}$		
(58) "	4	19	$8\frac{1}{2}$	×	$9\frac{1}{2}$		
(59) "	48	17	$6\frac{1}{2}$	×	$47\frac{1}{2}$		
(60) "	59	14	$7\frac{1}{4}$	×	$87\frac{1}{4}$		
(61) "	796	13	$4\frac{1}{2}$	×	$49\frac{1}{2}$		
(62) "	864	16	$6\frac{1}{4}$	×	$94\frac{1}{2}$		

## QUESTIONS FOR THE PUPIL

What do we find by Compound Multiplication?

What is the rule for Compound Multiplication when the multiplier does not exceed 12?

What is the rule when it exceeds 12, and is a composite number? also when it exceeds 12, and is not a composite number?

How do you multiply when the multiplier exceeds 20 or a hundred?

How do you multiply by parts, and how is the product of the fractions obtained?

How is Compound Multiplication proved when the multiplier is under 12, and also when it is a composite number?

## COMPOUND DIVISION.

By Compound Division we learn to divide a number consisting of several names into any required number of equal parts.

## RULE.

Place the divisor on the left of the dividend, with a curve between them.

Divide each denomination of the dividend, beginning at the left, by the divisor, and set down the quotient.

If when dividing any name there be a remainder, carry it to the next lower term as so many of that name as are equal to it, continue the division, and set down the quotient as before.

*Proof.*—Multiply the quotient by the divisor taking in the remainder if any.

## EXAMPLE.

Divide 251*l.* 17*s.* 9½*d.* into four equal parts.

$$\begin{array}{r}
 \begin{array}{ccc} \text{£} & \text{s.} & \text{d.} \\ 4 \overline{) 251 \ 17 \ 9\frac{1}{2}} \end{array} \\
 \hline
 \text{Quotient} \quad 62 \ 19 \ 5\frac{1}{4} - 3 \\
 \hline
 \text{Proof} \quad \underline{\underline{£ 251 \ 17 \ 9\frac{1}{2}}}
 \end{array}$$

The operation is practically performed thus:—fours in 2 six times and 1 over, set down 6 and carry 1: fours in 1 twice and 3 over, set down 2 and carry 3: 3 pounds are 6 shillings, 60 and 17 are 77, fours in 77, 19 times and 1 over 1 shilling is 12 pence, 12 and 9 are 21, fours in 21 five times and 1 over: 1 penny is 4 farthings, 4 and 3 are 7, fours in 7 one and 3 over, set down one farthing and the remainder 3.

This example shows that a fourth part of 251*l.* 17*s.* 9½*d.* is 62*l.* 19*s.* 5¼*d.* and three-fourths of a farthing.

## EXERCISES.

	£	s.	d.			£	s.	d.	
(1)	68	17	9½	÷	2	(9)	5060	0	7½ ÷ 10
(2)	42	12	3½	÷	3	(10)	8687	18	11½ ÷ 11
(3)	69	18	7½	÷	4	(11)	4711	11	7½ ÷ 12
(4)	748	15	0½	÷	5	(12)	98	14	7½ ÷ 7
(5)	176	19	10½	÷	6	(13)	67	19	1½ ÷ 9
(6)	407	14	2½	÷	7	(14)	864	1	7½ ÷ 12
(7)	8647	17	11½	÷	8	(15)	587	14	10½ ÷ 6
(8)	7508	13	6½	÷	9				

## RULE.

When the divisor exceeds 12, and is a composite number, divide successively by the factors.

## EXAMPLE.

Divide 12*l.* 17*s.* 9*d.* by 36.

$$\begin{array}{r}
 \begin{array}{r}
 \text{£} \quad \text{s.} \quad \text{d.} \\
 36 \left\{ \begin{array}{l} 3)12 \quad 17 \quad 9 \\ 12)4 \quad 5 \quad 11 \end{array} \right. \\
 \hline
 0 \quad 7 \quad 1\frac{1}{2} - \frac{1}{2} \\
 \hline
 4 \quad 5 \quad 11 \\
 \hline
 8
 \end{array} \\
 \text{Proof} \quad 12 \quad 17 \quad 9
 \end{array}$$

## EXERCISES.

(16)	24	17	6	÷	24
(17)	576	13	3	÷	36
(18)	447	12	2	÷	48
(19)	547	12	4	÷	56
(20)	740	13	4	÷	49
(21)	223	17	6	÷	72
(22)	92	8	11½	÷	28
(23)	278	18	3¾	÷	27
(24)	7	11	2½	÷	32
(25)	174	8	0	÷	66
(26)	246	8	11½	÷	81
(27)	129	7	9	÷	132

*Proof.*—Make the factors change places and divide again, or employ new factors where practicable.

When the divisor exceeds 12, and is not a composite number.

Divide 64*l.* 7*s.* 8½*d.* by 47.

## RULE.

Divide the pounds as in Simple Long Division. Multiply the remainder, 17, by 20, adding to it the shillings, 7. Divide again as in Simple Division. Multiply the remainder, 18, by 12, adding to it the pence, 8. Divide again as in Simple Division. Multiply the remainder, 36, by 4, adding to it the farthings, and divide as before. The quotient then is 1*l.* 7*s.* 4¾*d.* with 5 farthings remaining.

*Proof.*—By Compound Multiplication, taking in the remainder as shown in the example.

$$\begin{array}{r}
 \begin{array}{r}
 \text{£} \quad \text{s.} \quad \text{d.} \\
 47 \text{ ) } 64 \quad 7 \quad 8\frac{1}{2} \\
 \hline
 47 \\
 \hline
 17 \\
 20 \\
 \hline
 347 \\
 329 \\
 \hline
 18 \\
 12 \text{ Proof }
 \end{array}
 \begin{array}{r}
 \text{£} \quad \text{s.} \quad \text{d.} \\
 (1 \quad 7 \quad 4\frac{1}{2} \times 7 \\
 \hline
 13 \quad 18 \quad 11\frac{1}{2} \\
 \hline
 54 \quad 15 \quad 10 \\
 9 \quad 11 \quad 9\frac{1}{2} \\
 \hline
 \text{Remainder } 0 \quad 1\frac{1}{2} \\
 \hline
 \text{£} 64 \quad 7 \quad 8\frac{1}{2}
 \end{array}
 \end{array}$$
  

$$\begin{array}{r}
 224 \\
 188 \\
 \hline
 36 \\
 4 \\
 \hline
 146 \\
 141 \\
 \hline
 .5 \text{ remainder.}
 \end{array}$$

## EXERCISES.

(28)	470	16	4 $\frac{1}{2}$	÷	37	(34)	4817	16	8 $\frac{1}{2}$	÷	718
(29)	487	19	7 $\frac{1}{2}$	÷	146	(35)	97	13	6 $\frac{1}{2}$	÷	76
(30)	798	17	0 $\frac{1}{2}$	÷	365	(36)	647	14	7 $\frac{1}{2}$	÷	196
(31)	980	7	6 $\frac{1}{2}$	÷	478	(37)	870	0	6 $\frac{1}{2}$	÷	264
(32)	6427	14	9 $\frac{1}{2}$	÷	942	(38)	993	19	7 $\frac{1}{2}$	÷	489
(33)	7063	0	11 $\frac{1}{2}$	÷	806	(39)	7086	8	0 $\frac{1}{2}$	÷	785

When the divisor contains a fraction.

## RULE.

Multiply both the dividend and the divisor by the under figure of the fraction, 2, adding in the upper figure, 1, to the product of the divisor and the lower one: and divide by Short or Long Division as the case may require.

$$\begin{array}{r}
 \begin{array}{r}
 \text{£} \quad \text{s.} \quad \text{d.} \\
 2\frac{1}{2} \text{ ) } 24 \quad 4 \quad 0 \\
 \hline
 2 \\
 \hline
 5 \text{ ) } 49 \quad 9 \quad 1 \\
 \hline
 \text{£} 9 \quad 13 \quad 9
 \end{array}
 \end{array}$$

## EXERCISES.

£	s.	d.		£	s.	d.	
(40)	42	14	$6\frac{1}{4} \div 3\frac{1}{2}$	(46)	64	17	$6\frac{1}{2} \div 4\frac{1}{2}$
(41)	64	17	$7\frac{1}{4} \div 6\frac{1}{4}$	(47)	87	14	$2\frac{3}{4} \div 9\frac{1}{8}$
(42)	97	18	$8\frac{3}{4} \div 7\frac{3}{4}$	(48)	38	12	$5\frac{1}{4} \div 8\frac{3}{8}$
(43)	847	12	$5\frac{1}{2} \div 47\frac{1}{2}$	(49)	789	0	$6\frac{3}{4} \div 78\frac{1}{2}$
(44)	948	17	$6\frac{3}{4} \div 76\frac{3}{4}$	(50)	807	16	$10\frac{1}{4} \div 88\frac{3}{8}$
(45)	408	0	$10\frac{1}{2} \div 43\frac{3}{8}$	(51)	978	17	$6\frac{1}{4} \div 96\frac{3}{8}$

When the divisor contains several denominations.

£	s.	d.	£	s.	d.
7	8	4	32	16	8
20			20		
148			656		
12			12		
1780			7880		d.
			7120		$(4\frac{1}{4} \frac{1780}{1780})$
			760		
			4		
			8040		(1
			1780		
			1260		

## RULE.

Bring both divisor and dividend to the same denomination, and proceed in Simple Division. The answer will be an abstract number, and will indicate how often the divisor is contained in the dividend.

## EXERCISES.

£	s.	d.	£	s.	d.
(52)	764	16	9	864	14
(53)	987	13	$8\frac{1}{2}$	249	17
(54)	847	10	$0\frac{1}{4}$	24	19
(55)	210	3	$4\frac{1}{2}$	120	16
(56)	901	42	$10\frac{3}{4}$	710	10
(57)	7826	13	$3\frac{1}{4}$	637	14

58. In a large town there were 4768 children educated by 56 teachers; how many pupils on an average had each teacher?

59. There are about eight hundred millions of people in the world, and it is said that as many die in 32 years; how many die on an average in a year?

60. If so many die in a year, how many die in an hour, there being 8765 hours in a year?

61. A tax-gatherer collected 747*l.* 15*s.* 6*d.* per month the first six months of the year, and 547*l.* 17*s.* 8*d.* per month the

last six months of the year ; how much did he collect daily on an average for the whole year ?

62. How many lbs. of sugar at  $9\frac{1}{2}d.$  will  $3l. 0s. 11\frac{1}{2}d.$  purchase ?

63. What quantity of silk at  $3s. 5d.$  a yard amounts to  $15l. 10s. 11d.$  ?

64. In what time will a weekly payment of  $5l. 10s. 7d.$  amount to  $287l. 10s. 4d.$  ?

65. How many ounces of silver at  $5s. 2d.$  an ounce will amount to  $2790l.$  ?

66. What part of 637 cwt. is 2 tons 5 cwt. and 2 qrs. ?

67. What weight is the eighth part of 17 hogsheads of tobacco, each 5 cwt. ?

68. What quantity is contained 7 times in 91 acres 2 roods 11 poles ?

69. Required the ninth part of 8 acres 2 roods 35 poles.

70. How much is the tenth part of 12 weeks' wages at  $2l. 15s. 2\frac{1}{2}d.$  per week ?

71. If I get 2 cwt. 3 qrs. 4lbs. sugar for a dozen pairs of shoes, what is that for each pair ?

72. If  $12l. 4s. 1\frac{1}{2}d.$  is paid for 63 yards of carpet, what is that per yard ?

73. When sugar sells at  $3l. 7s. 8d.$  the cwt., what is that per lb. ?

74. Six pigs, weighing together 79 stones, are bought for  $20l. 4s. 10\frac{1}{2}d.$ ; required the price per stone.

75. If 609 quarters of wheat weigh 140 tons 5 cwt. 84 lbs., what is the weight of a bushel ?

#### QUESTIONS FOR THE PUPIL.

What is the use of Compound Division ?

What are the rules when the divisor does not exceed 12 ?

What is the rule when the divisor exceeds 12, and is a composite number ?

When it exceeds 12, and is not a composite number ?

What is the rule when the divisor contains a fraction ?

When the divisor contains several denominations ?

How is Compound Division proved ?

## REDUCTION.

**REDUCTION** is a method of changing the name of any quantity while its value continues unchanged.

Thus, the quantity 5 pounds, being changed into shillings, becomes 100 shillings; and this result may be produced by multiplying the 5 pounds by 20; that is, by as many shillings as are equal to a pound.

Again: the quantity 48 inches, being changed into feet, becomes 4 feet; and this result may be produced by dividing the 48 inches by 12; that is, by as many inches as are equal to a foot.

## REDUCTION DESCENDING.

## RULE.

To reduce a quantity of any name to an equivalent quantity of a lower name.

Multiply by the number which shows how many of the lower name make one of the given name.

## EXAMPLE 1.

Reduce 1 pound 5 shillings to pence, and also to farthings.

$$\begin{array}{r}
 \text{£} \quad \text{s.} \\
 1 \quad 5 \\
 20 \\
 \hline
 25 \text{ shillings.} \\
 12 \\
 \hline
 300 \text{ pence.} \\
 4 \\
 \hline
 4)1200 \text{ farthings.} \\
 12)300 \\
 \hline
 2,0)2,5 \\
 \hline
 \text{£1} \quad 5 \text{ Proof.}
 \end{array}$$

**Reasons for the rule.** 1 pound is equal to 20 shillings; therefore, any number of pounds is equal to 20 times as many shillings; and any number of pounds and shillings is equal to 20 times as many shillings as there are pounds, plus the shillings.



It is easy to multiply by 20, and add the shillings at the same time, as it shortens the process.

Shillings, are equal to 12 times as many pence; pence, to 4 times as many farthings; cwts. to 4 times as many quarters; quarters, to 28 times as many pounds, &c., &c.

## EXAMPLE 2.

Reduce 10 yards 2 feet 9 inches, to inches.

Here we say, 3 times 10 are 30, and 2 feet we take in, are 32 feet; then  $12 \times 2 = 24$ , and 9 we take in = 33; 3 and carry 3;  $12 \times 3 = 36$ , and 3 carried, are 39: thus, the 2 feet are added in with the feet, and the 9 inches with the inches.

This method applies to all denominations of money, weights, and measures throughout this Rule.

yds.	ft.	in.
10	2	9
	3	
<hr/>		
	32	feet
	12	
<hr/>		

12	{	(12) 393 inches
		(3) 132 9
<hr/>		

*Proof.*—Retrace the work, dividing by the digits by which you have previously multiplied. *Proof*... 10 2 9

## EXERCISES.

1. How many farthings are there in 23328 pence?
2. How many shillings are there in 348*l.*?
3. How many pence are there in 38*l.* 10*s.*?
4. How many pence are there in 58*l.* 13*s.*?
5. How many farthings in 58*l.* 13*s.*?
6. How many farthings in 59*l.* 13*s.* 6 $\frac{3}{4}$ *d.*?
7. How many pounds in 16 cwt. 2 qrs. 16 lbs.?
8. How many pounds in 14 cwt. 3 qrs. 16 lbs.?
9. How many grains in 3 lbs. 5 oz. 12 dwts. 16 grains?
10. How many grains in 7 lbs. 11 oz. 15 dwts. 14 grains?
11. How many hours in 20 years?
12. How many feet in an English mile?
13. How many gallons in 65 tuns?
14. How many minutes in 46 years, 21 days, 8 hours, 4 minutes (not taking leap years into account)?
15. How many square yards in 46 acres, 3 roods, 2 perches?
16. How many acres in 767 square miles?
17. How many cubic inches in 767 cubic feet?
18. How many quarts in 767 pecks?

## REDUCTION ASCENDING.

## RULE.

Divide the given quantity by that number of its units which is required to make one of the next higher denomination; the remainders, if any, will be of the denomination to be reduced. Proceed in the same manner until the highest required denomination is obtained.

## EXAMPLE 1.

Reduce 18,880 pence to shillings and pounds.

$$\begin{array}{r}
 12 \overline{)18880} \\
 \underline{120} \phantom{00} \\
 68 \phantom{00} \\
 20 \overline{)157,3} - 4 \\
 \underline{200} \phantom{0} \\
 78 \phantom{0} 13 \phantom{0} 4 \\
 \underline{760} \phantom{0} \\
 23 \phantom{0} 4
 \end{array}$$

*Answer.* 1573 shillings and 4 pence = 78*l.* 13*s.* 4*d.*

## EXAMPLE 2.

Reduce 157 yards, 3 quarters, to quarters; also to English ells.

$$\begin{array}{r}
 \text{yds. qr} \\
 157 \phantom{0} 3 \\
 \underline{4} \\
 5 \overline{)631} \\
 \underline{500} \phantom{0} \\
 131 \\
 \underline{126} \phantom{0} 1
 \end{array}$$

*Answer.* 631 quarters; and 126 English ells and 1 quarter.

## EXAMPLE 3.

Reduce 14,107 lbs. to tons.

$$\begin{array}{r}
 \text{lbs.} \\
 28 \text{ lbs. } \left\{ \begin{array}{l} 7 \overline{)14107} \\ \underline{4)2015 - 2} \\ \underline{4)503 - 3} \end{array} \right\} 23 \text{ lbs.} \\
 2,0 \overline{)12,5} - 3 \text{ qrs.} \\
 \underline{6} \phantom{0} 5 \text{ cwt.}
 \end{array}$$

*Answer.* 6 tons 5 cwt. 3 qrs. and 23 lbs.

*Proof.*—Reduction Ascending and Descending prove each other.

### EXERCISES.

19. How many pence in 93,312 farthings?
20. How many pounds in 6960 shillings?
21. How many pounds, &c., in 976 halfpence?
22. How many pounds, &c., in 7675 halfpence?
23. How many ounces and pounds in 4352 drams?
24. How many cwt., qrs., and pounds in 1864 pounds?
25. How many hundreds, &c., in 1668 pounds?
26. How many pounds troy in 115,200 grains?
27. How many pounds in 107,520 ounces avoirdupois?
28. How many hogsheads in 20,658 gallons?
29. How many days in 8760 hours?
30. How many English miles in 17,297,280 inches?
31. How many English ells in 576 nails?
32. How many cubic feet, &c., in 1,674,674 cubic inches?
33. How many yards in 767 Flemish ells?

### QUESTIONS FOR THE PUPIL.

What is Reduction? What is the difference between Reduction Descending and Reduction Ascending?

What is the Rule for Reduction Descending? What is the Rule for Reduction Ascending? How is Reduction proved?

### QUESTIONS FOUNDED ON THE TABLES, pages 19–23.

How are pounds reduced to farthings, and farthings to pounds, &c.?

How are tons reduced to drams, and drams to tons, &c.?

How are troy pounds reduced to grains, and grains to troy pounds, &c.?

How are pounds reduced to grains (apothecaries' weight), and grains to pounds, &c.?

How are Flemish, English, or French ells reduced to inches, or inches to Flemish, English, or French ells, &c.?

How are yards reduced to ells, or ells to yards, &c.?

How are miles reduced to square inches, or square inches to miles, &c.?

How are cubic feet reduced to cubic inches, or cubic inches to cubic feet, &c. ?

How are butts reduced to gallons, or gallons to butts, &c. ?

How are lasts (dry measure) reduced to pints, or pints to lasts, &c. ?

How are years reduced to days, or days to years, &c. ?

How are degrees (of the circle) reduced to seconds, or seconds to degrees, &c. ?

PROMISCUOUS EXERCISES ON ALL THE FOREGOING RULES.

1. A cheese weighing 15 lbs. cost 11s. 10½d. Required the cost per lb.

2. Convert 527 dollars, each 4s. 6d., into pounds.

3. How many pairs of shoes at 5s. 6d. a pair may be got for 16l. 4s. 6d. ?

4. Subtract 50l. 14s. 3d. from a thousand crowns.

5. A ship has a cargo of bale goods, measuring 4715 cubic feet. How many tons is that equal to at 40 feet per ton ?

6. Subtract 46 stones, each 14 lbs., from one ton.

7. A man having found a purse of 29 sovereigns, receives, on returning it to the owner, 4s. 6d. for every pound ; what is the amount of the reward ?

8. Add together 75 guineas, as many crowns, and as many pence.

9. Add 264 lbs., 264 cwt., 264 tons, and 264 ounces.

10. Reduce 13 cwt. 10 lbs., and 16 cwt. 10 oz., to whole numbers of one denomination.

11. If a barrel of tar weigh 3 cwt., what is the tonnage of a ship which carries 730 barrels ?

12. Reduce 17s. 8d. and 23l. 16s. 8d. to whole numbers of one denomination.

13. A person possessed of 200l. spends the following portions of that sum : 13l. 16s. 2d., 15l. 13s. 6d., 28l. 4s., and 10l. 12s. 4½d. Had he spent 19l. 9s. less, how much could have remained ?

14. Required the amount of 17 fares by a parliamentary train from London to Liverpool, 211 miles ; the fare being any per mile.

15. An oak tree contains 15 cubic feet of timber. Find the cost of 29 such trees, at 3s. 4d. the cubic foot.

16. Reduce 15 feet 5 inches, and 15 yards 5 inches, to whole numbers of one denomination.

17. If the brewing of 9 gallons of beer cost me 3*s.*, what does each pint cost?

18. Reduce 15 guineas and 17 dollars (each 4*s.* 6*d.*), to whole numbers of one denomination.

19. Convert 2387 packages, of 16 ounces each, into another number of packages, half of which shall contain 12 oz., and the other half 10 oz. each.

20. How many times does a clock tick between 12 P.M., on March 20th, and 21 minutes past 11 A.M., on the 15th December of the same year?

21. A person pays a debt of 460*l.* 16*s.* in sovereigns, half-sovereigns, crowns and shillings, of each an equal number. How many did he pay of each?

22. How much paper, at 10*d.* per quire, is equal in value to 35 quires, at 8*d.* per quire?

23. A land mile is 1760 yards, and a knot or nautical mile is 2000 yards. How many knots correspond to 1400 land miles?

24. My watch, at noon, indicated 11 hrs., 36 min., 32 sec. on the 13th of September; and again, at noon on the 27th of the month, it indicated 11 hrs., 38 min., 10 sec. Required its daily gain.

25. How many lbs. of cherries, at 8*d.* a lb., are worth 9 bushels of apples, at 3*s.* 6*d.* a bushel?

26. A man, whose weekly earnings are 17*s.* 6*d.*, saves a fifth part of that sum every fortnight. In what time will he save 50 guineas?

27. In payment of a debt of 16*l.* 5*s.* 6*d.*, I gave ten mahogany chairs, valued at 19*s.* 6*d.* each, two arm-chairs, each 27*s.*, and a chest of drawers. How much is reckoned for the drawers?

28. A has 9 thousand 9 hundred and 9 pounds, B has 12 thousand 12 hundred and 12 pounds, and C has 15 thousand 15 hundred and 15 pounds. How much have they together?

29. What cash must be given with 24 yards of cloth, at 8*s.* 3½*d.*, to pay for 6 cwt. sugar, at 38*s.* a cwt.?

30. An equivalent quantity of silk, worth 4*s.* 9*d.* per yard is given in exchange for 5 yards of calico, at 4½*d.*, and yards of Irish linen, at 3*s.* 6*d.* Required the quantity silk.

31. I gave 106*l.* 4*s.* for 32 pieces of cloth, each piece con

aining the same quantity, at  $2s. 5\frac{1}{2}d.$  per yard. How many yards were in each piece?

32. A offers to B 1350 feet of wood, at  $2s. 11d.$  a foot, for 3 pipes of wine, each 126 gallons. What price per gallon is offered?

33. I gave 26 dozen port wine, and 23 dozen sherry, the former worth  $32s. 6d.$ , and the latter worth  $43s.$  a dozen, for an equivalent quantity of rum, valued at  $14s.$  a gallon. How much rum did I receive?

34. A glass-cutter is paid  $14\frac{1}{2}d.$  for every glass that he cuts successfully, and  $7\frac{1}{2}d.$  for every one that he finishes in a certain degree imperfectly; moreover, he is fined  $4d.$  for every one that he breaks. Of  $6\frac{1}{2}$  dozen which pass through his hands, 8 are of inferior execution, 5 are broken, and the rest are well finished. Required the amount of his earnings.

35. I can gain  $4s. 6d.$  a-day by a certain apparatus, as soon as it is got ready. A mechanic, whom I employ to construct it, offers to finish it in 7 days, for  $5s.$  a-day; or, to prolong his daily labour, so as to have it done in 5 days, if I pay him  $7s. 6d.$  a-day. Which proposal should I accept, and what is the advantage?

## SECTION II.

### PROPORTION.

THE rule of Proportion is called also the *golden rule*, from its extensive utility; in some cases it is termed the *rule of three*; because, by means of it, when three numbers are given, a fourth, which is unknown, may be found.

The rule of proportion is divided into the *simple*, and the *compound*. Sometimes, also, it is divided into the *direct* and *inverse*,—"which is not accurate, as was shown by Hatton, in his *Arithmetic*, published a hundred years ago."

The pupil, to have accurate ideas of the rule of proportion, must be acquainted with a few simple but important principles connected with the nature of ratios, and the doctrine of proportion.

The following facts are evident:—

If the same or equal quantities are added to equal quantities

the sums are equal. Thus: if we add the same quantity, 4, for instance, to  $5 \times 6$ , and  $3 \times 10$ , which are equal, we shall have  $5 \times 6 + 4 = 3 \times 10 + 4$ .

Or, if we add equal quantities to those which are equal, the sums will be equal. Thus, since

$$5 \times 6 = 3 \times 10 \text{ and } 2 \times 2 = 4 \\ 5 \times 6 + 2 \times 2 \times 3 \times 10 + 4.$$

If the same, or equal quantities are subtracted from others which are equal, the remainders will be equal. Thus, if we subtract 3 from each of the equal quantities, 7 and  $5 + 2$ , we shall have

$$7 - 3 = 5 + 2 - 3 \\ \text{and since } 8 = 6 + 2 \text{ and } 4 = 3 + 1 \\ 8 - 4 = 6 + 2 - 3 + 1.$$

If equal quantities are multiplied by the same, or by equal quantities, the products will be equal. Thus, if we multiply the equals  $5 + 6$  and  $10 + 1$  by 3 we shall have

$$\overline{5 + 6} \times 3 = \overline{10 + 1} \times 3 \\ \text{and since } 4 + 9 = 13, \text{ and } 3 \times 6 = 18 \\ \overline{4 + 9} \times 3 \times 6 = 13 \times 18.$$

If equal quantities are divided by the same, or by equal quantities, the quotients will be equal. Thus, if we divide the equals 8 and  $4 + 4$  by 2, we shall have

$$\frac{8}{2} = \frac{4 + 4}{2} \\ \text{and since } 20 = 17 + 3 \text{ and } 10 = 2 \times 5 \\ \frac{20}{10} = \frac{17 + 3}{2 \times 5};$$

Ratio is the relation which exists between two quantities, and is expressed by two dots (:) placed between them—thus:  $5 : 7$  (read 5 is to 7), which implies that 5 has a certain relation to 7. The former quantity is called the antecedent, and the latter the consequent. If we invert the terms of a ratio we shall have their inverse ratio: thus  $7 : 5$  is the inverse of  $5 : 7$ . When we have three numbers given, then we can by this rule find a fourth, which has the same proportion to the third number that the second has to the first.

Thus, if the given numbers be 1, 2, 3, it is required to find a fourth number, which will have the same proportion to 3 the

the 2 has to 1. Now, the 2 is double the 1; therefore the required number must be double of the 3, that is 6. To express proportion the numbers are stated thus,  $1 : 2 :: 3 : 6$ , and are read thus, 1 is to 2 as 3 is to 6.

## EXAMPLE.

Find a fourth proportioned to the numbers, 4, 8, 6.

## RULE.

Place them thus, and multiply the second and third numbers together and divide by the first; the quotient is 12, which bears the same proportion to 6 that 8 does to 4.

$$\begin{array}{r} 4 : 8 :: 6 \\ \quad 6 \\ \hline 4)48 \\ \quad 12 \\ \hline \end{array}$$

## EXERCISES.

- |     |    |    |     |    |                              |
|-----|----|----|-----|----|------------------------------|
| (1) | To | 3  | 6   | 12 | } Find fourth proportionals. |
| (2) | To | 4  | 8   | 3  |                              |
| (3) | To | 3  | 6   | 8  |                              |
| (4) | To | 6  | 12  | 4  |                              |
| (5) | To | 10 | 150 | 68 |                              |

- |     |                              |  |  |  |   |      |      |      |
|-----|------------------------------|--|--|--|---|------|------|------|
| (6) |                              |  |  |  | { | 1020 | 68   | 150  |
| (7) | Find fourth proportionals to |  |  |  |   | 150  | 10   | 1020 |
| (8) |                              |  |  |  |   | 68   | 1020 | 10   |

Find a fourth proportional to the following numbers:—

- |      |    |         |          |                  |
|------|----|---------|----------|------------------|
| (9)  | To | 2 tons  | 17 tons  | and £25          |
| (10) | To | 10 lbs. | 50 lbs.  | and 5 shillings  |
| (11) | To | 9 yds.  | 36 yds.  | and 18 shillings |
| (12) | To | 5 lbs.  | 1 lb.    | and 15 shillings |
| (13) | To | 4 yds.  | 18 yds.  | and 2 shillings  |
| (14) | To | 1 cwt.  | 215 cwt. | and 50 shillings |
| (15) | To | 5 tons  | 50 tons  | and £27.         |

When the two first terms are of different denominations reduce them to the same.

To 3 oz., 112 lbs., and 2s. find a fourth proportional.

## RULE.

Multiply the 112 lb. by 16, to bring them to the same as the



first term, viz. to ounces : when this is done, the numbers stand thus, 3 oz. 1792 oz. 2s.

$$\begin{array}{r}
 \text{oz.} \quad \text{lbs.} \quad \text{s.} \\
 3 : 112 : : 2 \\
 \quad 16 \\
 \hline
 \quad 672 \\
 112 \\
 \hline
 1792 \\
 \quad 2 \\
 \hline
 3)3584 \\
 \hline
 1194 - 2 \\
 \hline
 \hline
 \end{array}$$

Find a fourth proportional to the following numbers.

(16)	To 2 qrs.	240 yds.	12s.
(17)	To 5s.	80l.	1 yd.
(18)	To 5 cwt.	6000 lbs.	8s.
(19)	To 5s. 6d.	140s.	2 yds.
(20)	To 3s. 4d.	1l. 10s.	1 yd.

When the third term is of different denominations, reduce it to the lowest denomination mentioned in it.

To 2 lbs. 112 lbs. and 5s. 6d. find a fourth proportional.

#### RULE.

Multiply the 5s. by 12, adding the 6d.; it then stands thus : 2 lbs. 112 lbs. 66d. Proceed as before instructed.

$$\begin{array}{r}
 \text{lb.} \quad \text{lb.} \quad \text{s. d.} \\
 2 : 112 : : 5 \text{ } 6 \\
 \quad 66 \\
 \hline
 \quad 672 \\
 672 \\
 \hline
 2)7392 \\
 \hline
 3696 \text{ pence.} \\
 \hline
 \hline
 \end{array}$$

Find the fourth proportional to the following numbers:—

(21)	To 2 tons	14 tons	28l. 10s. 0d.
(22)	To 5 brls.	100 brls.	18s. 6d.
(23)	To 4 lbs.	112 lbs.	5½d.

If 24 lbs. of cheese cost 1l. 8s. what is the price of 3 lbs.

## RULE.

In this question there are two things mentioned, cheese and money. Is the answer to the question to be given in cheese or money? You perceive it is to be given in money. Place the money *l. 8s.* in the third place. Having done this, you must now consider where you are to place the 24 lbs. and the 3 lbs. Read the question, and you will see that the answer must be less than the third term,

lb.	lb.	£	s.
24	:	3	:
		1	8
		20	
		—	
		28	
		3	
		—	
	{	2	84
		—	
	{	12	42
		—	
		3s.	6d.

for 3 lbs. will not cost so much as 24 lbs. Since, then, the answer is to be less, put the lesser number for the second term, and the greater for the first.

In all questions the third term must be of the same nature as the answer required; and if the answer is to be greater than the third term, put the greater second; if it is to be less, put the less second.

24. What will 215 cwt. of madder cost at 50 shillings per cwt.?

25. I wish to have 30 yards of cloth 2 yards wide, with baise 3 yards in breadth to line it; how much of the latter shall I require?

26. At 10 shillings per barrel, what will be the price of 130 barrels of barley?

27. A merchant agreed with a carrier to bring 12 cwt. of goods 70 miles for 13 crowns; but, his waggon being heavily laden, the carrier was obliged to unload 2 cwt.; how far should he carry the remainder for the same money?

28. What will 150 cwt. of cheese cost at 3*l.* per cwt.?

29. If I lend a person 400*l.* for 7 months, how much ought he to lend me for 12?

30. How far will a person walk in 70 days at the rate of 30 miles a day?

31. If I spend 4*l.* in one week, how much shall I spend in 52?

32. There are provisions in a town sufficient to support 4000 soldiers for 3 months; how many must be sent away to make the provisions last 8 months?



2. If 3 yards of cloth cost 4s. 9 $\frac{3}{4}$ d. how much can be bought for 2l.?

s. d.	£	yds.	yds.	yds.	qrs.	nls.
4 9 $\frac{3}{4}$	: 2	:: 3	$\frac{1920 \times 3}{231}$	$= 24$	3	3
12	20					
57 pence	40					
4	12					
231 farthings	480 pence					
	4					
	1920 farthings.					

The lowest denomination in either is farthings, so there is evidently the same ratio between 4s. 9 $\frac{3}{4}$ d., and 2l. as between the numbers of farthings they contain respectively. For there is the same ratio between any two quantities as between two others which are equal to them.

3. If 4 cwt. 3 qrs. 17 lbs. of meat cost 19l., how much will 7 cwt. 2 qrs. cost?

cwt.	qrs.	lbs.	cwt.	qrs.	£	£	£	s.	d.
4	3	17	: 7	2	:: 19	$\frac{840 \times 19}{549}$	$= 29$	1	5
4			4						
19 qrs.	30 qrs.								
28	28								
549 lbs.	840 lbs.								

The lowest denomination in either is pounds.

#### EXERCISES.

41. If an ounce of spice cost 4s., what will be the price of 16 lbs.?

42. What is the price of 17 tons of butter, at £5 per cwt.?

43. What will 224 lb. 6 oz. of spice come to, at 3s. per ounce?

44. What will 156 cwt. 2 qrs. of sugar come to, at 7d. per lb.?

45. If 1 yard of cloth cost 25s., what will 110 yards 2 qrs. and 3 nails, come to?

46. If 1 cwt. of butter cost 126s., how much will 17 cwt. 2 qrs. 7 lbs. cost?

47. How much beef can be bought for 760*l.* 12*s.* at 32*s.* per cwt.?

48. If 12 lbs. 6 oz. 4 dwt. cost 150*l.*, what will 3 lbs. 1 oz. 11 dwt. cost?

If the third term consists of more than one denomination.

### RULE.

Reduce it to the lowest denomination which it contains, then multiply it by the second, and divide the product by the first term. The answer will be of that denomination to which the third has been reduced, and must sometimes be changed to a higher.

### EXAMPLES.

1. If 3 yards cost 9*s.* 2½*d.*, what will 327 yards cost?

$$\begin{array}{rcl}
 \text{yds.} & \text{yds.} & \text{s. d.} \\
 3 & : 327 & : : 9 \quad 2\frac{1}{2} \\
 & & \underline{12} \\
 & & .110 \text{ pence} \\
 & & \underline{4} \\
 & & 441 \text{ farthings.}
 \end{array}
 \quad
 \begin{array}{l}
 327 \times 441 \\
 \hline
 3
 \end{array}
 \text{ farthings} = \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 50 \quad 1 \quad 5\frac{1}{2} \end{array}$$

Here the lowest denomination in the third term is farthings.

2. If 2 yards 3 qrs. cost 11½*d.*, what will 27 yds. 2 qrs. 2 nls. cost?

$$\begin{array}{rcl}
 \text{yds. qrs.} & \text{yds. qrs. nls.} & \text{d.} \\
 2 \quad 3 & : 27 \quad 2 \quad 2 & : : 11\frac{1}{2} \\
 4 & \quad 4 & \quad 4 \\
 \hline
 11 \text{ qrs.} & 110 & 45 \\
 4 & 4 & \hline
 44 \text{ nails} & 442 \text{ nails} & 
 \end{array}
 \quad
 \begin{array}{l}
 442 \times 45 \\
 \hline
 44
 \end{array}
 \text{ farthings} = \begin{array}{r} \text{s.} \quad \text{d.} \\ 9 \quad 5 \end{array}$$

The lowest denomination in the first and second is nails, and in the third farthings.

Reducing the third term generally enables us to perform the required multiplication and division with more facility. It is sometimes, however, unnecessary.

## EXAMPLE.

If 3 lbs. cost 3*l.* 11*s.* 4½*d.*, what will 96 lbs. cost?

$$3 : 96 :: 3 \text{ } 11 \text{ } 4\frac{1}{2} : \frac{3 \text{ } 11 \text{ } 4\frac{1}{2} \times 96}{3} = 3 \text{ } 11 \text{ } 4\frac{1}{2} \times 32 = 114 \text{ } 4 \text{ } 8.$$

*£ s. d.*

## EXERCISES.

49. At 18*s.* 6*d.* per cwt., what will 120 cwt. cost?
50. At 3¼*d.* per pound, what will 1 cwt. come to?
51. What will 120 acres of land come to, at 14*s.* 6*d.* per acre?
52. How much would 324 pieces of cloth cost, at 2*s.* 8½*d.* a piece?
53. What is the price of 132 yards of cloth, at 16*s.* 4*d.* per yard?
54. If 1 ounce of spice costs 3*s.* 4*d.*, what will 18 lbs. 10 oz. cost?
55. If 1 lb. of tea costs 6*s.* 8*d.*, what will 2 cwt. 3 qrs. cost?
56. At 15*s.* 6*d.* per yard, what will 76 yds. 3 qrs. come to?
57. At 14*s.* 4*d.* per cwt., what will be the cost of 12 cwt. 2 qrs.?
58. If 1 cwt. of butter costs 6*l.* 6*s.*, what will 17 cwt. 2 qrs. 7 lbs. amount to?
59. If the shilling loaf weigh 3 lbs. 6 oz. when flour sells at 1*l.* 13*s.* 6*d.* per cwt., what should be its weight when flour sells at 1*l.* 7*s.* 6*d.*?
60. If 1 lb. of spice cost 10*s.* 8*d.*, what is half an ounce worth?

## MISCELLANEOUS EXERCISES IN SIMPLE PROPORTION.

Suppose that a bale of merchandise weighs 300 lbs., and costs 15*l.* 4*s.* 9*d.*; that the duty is 2*d.* per pound; that the freight is 25*s.*, and the portorage home is 1*s.* 6*d.*; how much does 1 lb. stand me in?

lb.	lb.	£	s.	d.
300	: 1	: 19	1	3
		20		
		<hr/>		
		381		
		12		
		<hr/>		
300	)	4575		

15½*d.* Answer.

£	s.	d.
15	4	9 cost
2	10	0 duty
1	5	0 freight
0	1	6 portorage
<hr/>		
£19	1	3 Total.

61. Received 4 pipes of oil containing 480 gallons, which cost  $5s. 5\frac{1}{2}d$  per gallon; paid for freight  $4s.$  per pipe; for duty  $6d.$  a gallon; for portorage  $1s.$  per pipe; what did the whole cost, and what does it stand me in per gallon?

62. Bought three sorts of brandy and an equal quantity of each sort; one sort at  $5s.$ , another at  $6s.$ , and the third at  $7s.$ ; what is the cost of the whole, one gallon with another?

63. Bought three kinds of vinegar, and an equal quantity of each kind: one at  $3d.$ , another at  $4d.$ , and another at  $4\frac{1}{2}d.$  per quart. Having mixed them, I wish to know what the mixture cost me per quart.

64. Bought four kinds of salt, 100 barrels of each; and the prices were  $14s.$ ,  $16s.$ ,  $17s.$ , and  $19s.$  per barrel. If I mix them together, what will the mixture have cost me per barrel?

65. How many reams of paper, at  $9s. 9d.$  and  $12s. 3d.$  per ream, shall I have if I buy  $55l.$  worth of both, but an equal quantity of each?

A vintner paid  $171l.$  for three kinds of wine: one kind was  $8l. 10s.$ , another  $9l. 5s.$ , and the third  $10l. 15s.$  per hhd. He had of each an equal quantity, the amount of which is required.

£	s.
8	10
9	5
10	15

28 10 the price of one hogshead of each.

$$\begin{array}{r} 28 \text{ s.} \\ 28 \text{ 10} \end{array} : 171 : : 3 : \frac{£171 \times 3}{£28 \text{ 10}} = 18 \text{ hhds.}$$

66. Bought three kinds of salt, and of each an equal quantity; one was  $14s.$ , another  $16s.$ , and the third  $19s.$  the barrel, and the whole price was  $490l.$ ; how many barrels had I of each?

67. A merchant bought goods to the amount of  $1450l.$ , with an agreement to deduct  $1l.$  per cent. for prompt payment; what has he to pay?

68. A captain of a ship is provided with 2400 lbs. of bread for 200 men, of which each man gets 4 lbs. per week; how long will it last?

69. How long would 3150 lbs. of beef last 25 men, if they got 12 oz. each three times per week?

70. A fortress contains 700 men, who consume each 10 lbs. per week: it is provided with 184,000 lbs. of provisions; how long will they last?

71. In the copy of a work containing 327 pages, a remarkable passage commences at the end of the 156th page; at what page may it be expected to begin in a copy containing 400 pages?

72. Suppose 100 cwt. 2 qrs., 14 lbs. of beef for ship's use were to be cut up in pieces of 4 lbs., 3 lbs., 2 lbs., 1 lb., and  $\frac{1}{2}$  lb.—there being an equal number of each; how many pieces would there be in all?

Suppose that a greyhound makes 27 springs while a hare makes 25, and that their springs are of equal length; in how many springs will the hare be overtaken, if she is 50 springs before the hound?

The time taken by the greyhound for one spring is to that required by the hare, as 25 : 27, as 1 :  $\frac{27}{25}$ , or as 1 :  $1\frac{2}{25}$ .

The greyhound, therefore, gains  $\frac{2}{25}$  of a spring during every spring of the hare. Therefore,  $\frac{2}{25} : 50 :: 1 \text{ spring} : 50 \div$

$\frac{2}{25} = 675$ , the number of springs the hare will make before she is overtaken.

73. If a ton of tallow costs 35*l.*, and is sold at the rate of 10 per cent. profit, what is the selling price?

74. If a ton of tallow costs 37*l.* 10*s.*, at what rate must it be sold to gain by 15 tons the price of 1 ton?

75. Bought 45 barrels of beef at 21*s.* per barrel; among them are 16 barrels, 4 of which would be worth only 3 of the rest; how much must I pay?

76. If 840 eggs are bought at the rate of 10 for a penny, and 240 more at 8 for a penny, do I lose or gain if I sell them all at 18 for 2*d.*?

77. If a pound (troy weight) of silver is worth 66*s.*, what is the value of a pound avoirdupoise?

78. When A has travelled 68 days at the rate of 12 miles a day, B, who had travelled 48 days, overtook him; how many miles a day did B travel, allowing both to have started from the same place?



79. If the value of a pound avoirdupoise weight be 4*l.* 0*s.* 2½*d.*, how much can be had for one pound troy?

80. A ton of coals yields about 9000 cubic feet of gas; a street lamp consumes about 5, and an argand burner (one in which the air passes through the centre of the flame), 4 cubic feet in an hour; how many tons of coal would be required to keep 17,493 street lamps, and 192,724 argand burners, in shops, &c., lighted for 1000 hours?

81. The gas consumed in London requires about 50,000 tons of coal per annum. For how long a time would the gas this quantity may be supposed to produce (at the rate of 9000 cubic feet per ton) keep the argand light (consuming 4 cubic feet per hour) constantly burning?

82. An acre of coals 2 feet thick yields 3000 tons; and one five feet thick 8000; how many acres of 5 feet thick would give the same quantity as 48 of 2 feet thick?

### COMPOUND PROPORTION.

Compound Proportion enables us, although two or more proportions are contained in the question, to obtain the required answer by a single stating.

In Compound Proportion there are 3 or more ratios, one of them imperfect, and the rest perfect.

#### RULES.

1. Place the quantity belonging to the imperfect ratio as the third term of the proportion.

2. Put down the terms of each of the other ratios in the first and second places—in such a way that the antecedents may form one column, and the consequents another. In setting down each ratio, consider what effect it has upon the answer: if to increase it, set down the larger term as consequent, and the smaller as antecedent; if to diminish it, set down the smaller term as consequent, and the larger as antecedent.

3. Multiply the quantity in the third term by the product of all the quantities in the second, and divide the result by the product of all those in the first.

#### EXAMPLE.

1. If 5 men build 16 yards of a wall in 20 days, in how many days would 17 men build 37 yards?

The question, briefly put down, will be as follows:—

5 men	}	conditions which give 20 days
16 yards		
20 days		imperfect ratio
? days		the number sought
17 men	}	conditions which give the required number of days.
37 yards		

The imperfect ratio consists of days; therefore we are to put 20, the given number of days, in the third place. Two ratios remain to be set down—that of numbers of men, and that of numbers of yards. Taking the former first, we ask ourselves how it affects the answer, and find that the more men there are the smaller the required number will be, since the greater the number of men the shorter the time required to do the work. We, therefore, set down 17 as antecedent, and 5 as consequent. Next, considering the ratio consisting of yards, we find that the larger the number of yards the longer the time before they are built; therefore, increasing their number increases the quantity required. Hence, we put down 37 as consequent, and 16 as antecedent; and the whole will be as follows:—

$$\begin{array}{rcl}
 \text{Men} & \text{Men} & \text{days} \\
 17 : 5 :: 20 & & \\
 16 : 37 & \text{Men} & \text{Men days} \\
 \text{and } 17 : 5 :: 20 : 20 \times 5 \times 37 & & \\
 16 : 37 & & 17 \times 16 = 18.6 \text{ days nearly.}
 \end{array}$$

The result obtained by the rule is the same as would be found by taking in succession the two proportions supposed by the question. Thus—

If 5 men would build 16 yards in 20 days, in how many days would they build 37 yards?

$$16 : 37 :: 20 \frac{37 \times 20}{16} = \left\{ \begin{array}{l} \text{number of days which 5 men would} \\ \text{require to build 37 yards.} \end{array} \right.$$

If 5 men would build 37 yards in  $\frac{20 \times 37}{16}$  days, in how many days would 17 men build them?

$$\begin{array}{l}
 17 : 5 :: \frac{20 \times 37}{16} : \frac{20 \times 37}{16} \times 5 \div 17 = \\
 \frac{20 \times 5 \times 37}{17 \times 16}, \text{ the number of days found by the rule.}
 \end{array}$$

2. If 3 men, in 4 days of 12 working hours each, build 37 rods, in how many days of 8 working hours ought 22 men to build 970 rods of brickwork?

3 men	Men	Men	days	$\frac{4 \times 3 \times 12 \times 970}{22 \times 8 \times 37} =$
4 days	22 :	3 ::	4	
12 hours	8 :	12		
37 rods	37 :	970		21 days 5 hrs. $\frac{4976}{6512}$
<hr/>				
1 days				
8 hours				
22 men				
970 rods				

The number of days is the quantity sought; therefore 4 days constitutes the imperfect ratio, and is put in the third place. The more men the fewer the days necessary to perform the work; therefore 22 is put first, and 3 second. The smaller the number the working hours in the day the larger the number of days; hence 8 is put first, and 12 second. The greater the number of rods the greater the number of days required to build them; consequently 17 is put first, and 970 second.

The process may often be shortened by dividing one term in the first and one in the second place, or one in the first and one in the third place by the same number.

#### EXAMPLE 1.

If the carriage of 32 cwt. for 5 miles costs \$6., how much will the carriage of 160 cwt. 20 miles cost?

$$\frac{32 : 160 :: 8}{5 : 20 ::} \frac{160 \times 20 \times 8}{32 \times 5} = 160.$$

Dividing 32 and 160 by 32 we have 1 and 5 as quotients; dividing 5 and 20 by 5 we have 1 and 4, and the proportion will be—

$$\frac{1 : 5 :: 8 : 8 \times 5 \times 4 = 160.}{1 : 4}$$

We are to continue this kind of division as long as possible, that is, so long as any one number will measure a quantity in the first, and another in the second place; or one in the first and another in the third place. This will, in some instances change the quantities into unity; which, of course, may be omitted. This process is termed cancelling.

## EXAMPLE 2.

If 28 loads of stone of 15 cwt. each, build a wall 20 feet long and 7 feet high, how many loads of 19 cwt. will build one 323 feet long and 9 feet high?

cwt.	cwt.	loads.	
19	15	:: 28	$\frac{15 \times 323 \times 9 \times 28}{19 \times 20 \times 7} = 459.$
20	: 323		
7	: 9		

Dividing 7 and 28 by 7, we obtain 1 and 4. Substituting these, we have—

19	15	:: 4
20	: 323	
1	: 9	

Dividing 20 and 15 by 5, the quotients are 4 and 3.

19	3	:: 4
4	: 323	
1	: 9	

Dividing 4 and 4 by 4, the quotients are 1 and 1.

19	3	:: 1
1	: 323	
1	: 9	

Dividing 19 and 323 by 19, the quotients are 1 and 17.

1	3	:: 1 :	$3 \times 17 \times 9 = 459.$
1	: 17		
1	: 9		

In this process, we merely divide the first and second, or first and third terms, by the same number, which does not alter the proportion. Or we divide the numerator and denominator of the fraction, found as the fourth term, by the same number, which does not alter the quotient.

## EXERCISES.

1. If 240*l.* in 16 months gains 64*l.*, how much will 60*l.* gain in 6 months?

2. With how many pounds sterling could I gain 5*l.* per annum if with 450*l.* I gain 30*l.* in 16 months?

3. A merchant agrees with a carrier to bring 15 cwt. of goods 40 miles for 10 crowns; how much ought he to pay in proportion, to have 6 cwt. carried 32 miles?

4. If 20 cwt. are carried the distance of 50 miles for 5*l*., how much will 40 cwt. cost, if carried 100 miles?

5. If 200 lb. of merchandise are carried 40 miles for 3*s*., how many pounds might be carried 60 miles for 22*l*. 14*s*. 6*d*.?

6. If 286 lbs. of goods are carried 20 miles for 3*s*., how many miles might 4 cwt. 3 qrs. be carried for 32*l*. 6*s*. 8*d*.?

7. If a wall of 28 feet high were built in 15 days by 68 men, how many men would build a wall 32 feet high in 8 days?

8. If 1 lb. of thread make 3 yards of linen  $1\frac{1}{2}$  yard wide, how many pounds of thread would be required to make a piece of linen 45 yards long and a yard wide?

9. If 3 lbs. of worsted make 10 yards of stuff  $1\frac{1}{2}$  yard broad, how many pounds would make a piece 100 yards long and  $1\frac{1}{2}$  yard broad?

10. If 80,000 cwt. of ammunition are to be removed from a fortress in 9 days, and it is found that in 6 days 18 horses have carried away 4500 cwt., how many horses would be required to carry away the remainder in 3 days?

11. Three masters, who have each 8 apprentices, earn 36*l*. in 5 weeks—each consisting of 6 working days; how much would 5 masters, having 10 apprentices each, earn in 8 weeks, working  $5\frac{1}{2}$  days per week, the wages being in both cases the same?

12. If 6 shoemakers, in 4 weeks, make 36 pair of men's and 24 pair of women's shoes, how many pair of each kind would 18 shoemakers make in 5 weeks?

13. If 12 horses in 5 days draw 44 tons of stones, how many horses would draw 132 tons the same distance in 18 days?

14. If 27*s*. are the wages of 4 men for 7 days, what will be the wages of 14 men for 10 days?

15. If 120 bushels of corn last 14 horses 56 days, how many days will 90 bushels last 6 horses?

16. If a footman travels 130 miles in 3 days when the days are 14 hours long, in how many days of 7 hours each will he travel 390 miles?

17. If the price of 10 oz. of bread, when the flour is 1*s*. 10½*d*. per stone is one penny, what must be paid for 3 lbs. 12 oz. when the flour is 2*s*. 6*d*. per stone?

18. Five compositors, in 16 days of 14 hours each, compose 20 sheets of 24 pages in each sheet, 50 lines n.

page, and 40 letters in a line; in how many days of seven hours each may 10 compositors compose a volume, to be printed in the same letter, containing 40 sheets, 16 pages in a sheet, 60 lines in a page, and 50 letters in a line?

### QUESTIONS FOR THE PUPIL.

What is the rule of proportion; and is it ever called by any other name?

What is the difference between simple and compound proportion?

What is a ratio? What are the antecedent and consequent?

What is an inverse ratio?

How is a fourth proportional to three quantities found?

How is a question in the simple rule of three to be stated, and solved?

Is it necessary to divide the rule of three into the direct, and inverse?

How is a question in the rule of proportion solved, if the question in the third term consists of more than one denomination?

How is a question in the rule of compound proportion stated, &c.?

Can any of the terms of a question, in the rule of compound proportion, ever be lessened, or altogether banished?

### PRACTICE.

Practice is an abridged mode of performing operations in the rule of Simple Proportion; and is so named because it is much used by persons in trade.

A less number is said to be the aliquot part of a greater, when the less number is contained in the greater any number of times without leaving any remainder: thus, 3 is the aliquot part of 9 or of 15; 4 of 16 or 20; and 2 of 6, 8, or 12.

The aliquant parts of a number are those which do not measure it—that is, which cannot be multiplied by any integer so as to produce it—the aliquot parts are, as we have seen before, those which measure it.

TABLE OF ALIQUOT PARTS.—MONEY.

Of a Pound.			Of a Pound.			Of a Shilling.			
s.	d.		d.			d.			
10	0	=	$\frac{1}{2}$	10	=	$\frac{1}{2}$	6	=	$\frac{1}{4}$
8	8	=	$\frac{1}{3}$	8	=	$\frac{1}{3}$	4	=	$\frac{1}{3}$
5	0	=	$\frac{1}{4}$	7 $\frac{1}{2}$	=	$\frac{1}{4}$	3	=	$\frac{1}{3}$
4	0	=	$\frac{1}{2}$	6	=	$\frac{1}{5}$	2	=	$\frac{1}{5}$
3	4	=	$\frac{1}{6}$	5	=	$\frac{1}{6}$	1 $\frac{1}{2}$	=	$\frac{1}{6}$
2	6	=	$\frac{1}{5}$	4	=	$\frac{1}{5}$	1	=	$\frac{1}{5}$
2	0	=	$\frac{1}{5}$	3	=	$\frac{1}{6}$	$\frac{1}{2}$	=	$\frac{1}{6}$
1	8	=	$\frac{1}{5}$	2	=	$\frac{1}{6}$	$\frac{1}{3}$	=	$\frac{1}{6}$
1	4	=	$\frac{1}{5}$	1 $\frac{1}{2}$	=	$\frac{1}{6}$	$\frac{1}{4}$	=	$\frac{1}{6}$
1	3	=	$\frac{1}{6}$	1	=	$\frac{1}{6}$	Of a Penny.		
1	0	=	$\frac{1}{6}$				$\frac{1}{2}$	=	$\frac{1}{2}$
							$\frac{1}{4}$	=	$\frac{1}{4}$

These Tables must be learnt by the pupil.

TABLE OF THE ALIQUOT PARTS OF WEIGHTS AND MEASURES.

AVOIRDUPOISE WEIGHT.		TROY WEIGHT.		CLOTH MEASURE.	
Of a Ton—20 cwt.		Of a pound.		Of a yard.	
10 cwt.	= $\frac{1}{2}$	6 ozs.	= $\frac{1}{4}$	2 qrs. 1 nl.	= $\frac{1}{2}$
5 "	= $\frac{1}{4}$	4 "	= $\frac{1}{3}$	1 0 "	= $\frac{1}{4}$
4 "	= $\frac{1}{5}$	3 "	= $\frac{1}{4}$	2 "	= $\frac{1}{5}$
2½ "	= $\frac{1}{8}$	2 "	= $\frac{1}{6}$	1 "	= $\frac{1}{6}$
2 "	= $\frac{1}{10}$	Of an ounce.		Of an English ell.	
Of a cwt.		10 dwts.	= $\frac{1}{2}$	2 qrs. 2 nl.	= $\frac{1}{2}$
qrs. lbs.		5 "	= $\frac{1}{4}$	1 1 "	= $\frac{1}{4}$
2 or 56	= $\frac{1}{2}$	4 "	= $\frac{1}{5}$	1 0 "	= $\frac{1}{5}$
1 or 28	= $\frac{1}{4}$	2 "	= $\frac{1}{10}$	2 "	= $\frac{1}{6}$
16	= $\frac{1}{8}$	Of a dwt.		1 "	= $\frac{1}{6}$
14	= $\frac{1}{10}$	12 gra.	= $\frac{1}{2}$	Of a Flemish ell.	
7	= $\frac{1}{20}$	8 "	= $\frac{1}{3}$	1 qr. 2 nl.	= $\frac{1}{2}$
Of a ¼ cwt. or 56 lbs.		6 "	= $\frac{1}{4}$	1 0 "	= $\frac{1}{4}$
28 lbs.	= $\frac{1}{2}$	4 "	= $\frac{1}{5}$	2 "	= $\frac{1}{6}$
14 "	= $\frac{1}{4}$	3 "	= $\frac{1}{6}$	3 "	= $\frac{1}{6}$
8 "	= $\frac{1}{8}$	2 "	= $\frac{1}{10}$	1 "	= $\frac{1}{6}$
7 "	= $\frac{1}{10}$	—		Of a French ell.	
3½ "	= $\frac{1}{8}$	LAND MEASURE.		3 qrs. 0 nl.	= $\frac{1}{2}$
Of a ¼ cwt. or 28 lbs.		Of an acre.		2 0 "	= $\frac{1}{3}$
14 lbs.	= $\frac{1}{2}$	2 roods	= $\frac{1}{2}$	1 2 "	= $\frac{1}{4}$
7 "	= $\frac{1}{4}$	1 "	= $\frac{1}{4}$	1 0 "	= $\frac{1}{5}$
4 "	= $\frac{1}{7}$	32 poles	= $\frac{1}{2}$	3 "	= $\frac{1}{6}$
3½ "	= $\frac{1}{8}$	20 "	= $\frac{1}{5}$	2 "	= $\frac{1}{6}$
2 "	= $\frac{1}{10}$	16 "	= $\frac{1}{6}$	1 "	= $\frac{1}{6}$
Of a pound—16 ozs.		8 "	= $\frac{1}{10}$		
8 ozs.	= $\frac{1}{2}$				
4 "	= $\frac{1}{4}$				
2 "	= $\frac{1}{8}$				

When the price is less than a penny.

### RULE.

Divide by the aliquot parts of a penny, as this will give the answer in pence; divide then by 12 and by 20, to obtain the value in shillings and pounds.

What is the price of 4268  
eggs at  $\frac{1}{2}d.$  each?

$$\begin{array}{r} \frac{1}{2}d. = \frac{1}{2})4268 \\ \hline 12)2134 \\ \hline 20)17\ 7\ 10 \\ \hline \pounds 8\ 17\ 10. \end{array}$$

What is the price of 4268  
at  $\frac{1}{4}d.$  each?

$$\begin{array}{r} \frac{1}{2} = \frac{1}{2})4268 \\ \hline \frac{1}{4} = \frac{1}{4})2138 \\ \hline 1067 \\ \hline 12\ 3201 \\ \hline 20)26\ 6\ 9 \\ \hline \pounds 13\ 6\ 9 \end{array}$$

### EXERCISES.

- (1) 6846 @  $\frac{1}{2}d.$  each  
(2) 963 @  $\frac{1}{4}d.$  "  
(3) 1572 @  $\frac{1}{8}d.$  "  
(4) 8742 @  $\frac{1}{16}d.$  "  
(5) 504 @  $\frac{1}{32}d.$  "  
(6) 1670 @  $\frac{1}{64}d.$  "

- (7) 854 @  $\frac{1}{8}d.$  each  
(8) 715 @  $\frac{1}{16}d.$  "  
(9) 5049 @  $\frac{1}{32}d.$  "  
(10) 1846 @  $\frac{1}{64}d.$  "  
(11) 819 @  $\frac{1}{128}d.$  "  
(12) 460 @  $\frac{1}{256}d.$  "

When the price is less than a shilling.

### RULE.

Take the aliquot parts of a shilling, and divide by 20.

What is the value of 4608 lbs. of  
soap, @  $3\frac{1}{2}$  per lb.

$$\begin{array}{r} 3d. = \frac{1}{4})4608 \\ \hline \frac{1}{2}d. = \frac{1}{2})1152 \\ \hline 192 \\ \hline 20)1844 \\ \hline \pounds 67\ 4\ \text{Ans.} \end{array}$$

What is the value of 4608 lbs. of  
sugar @  $6\frac{1}{2}d.$  per lb.

$$\begin{array}{r} 6d. = \frac{1}{2})4608 \\ \hline \frac{1}{4}d. = \frac{1}{4})2304 \\ \hline 288 \\ \hline 20)2592 \\ \hline \pounds 129\ 12\ \text{Ans.} \end{array}$$



(13) 6423 @ 1d. each.	(25) 4278 @ 5s. each.
(14) 3684 @ 1½ "	(26) 6496 @ 6s. "
(15) 2786 @ 1¼ "	(27) 4378 @ 6s. "
(16) 5963 @ 1½ "	(28) 4021 @ 7s. "
(17) 4285 @ 2s. "	(29) 8642 @ 8s. "
(18) 6784 @ 2½ "	(30) 7643 @ 8s. "
(19) 4388 @ 2½ "	(31) 8765 @ 9s. "
(20) 8563 @ 2¾ "	(32) 2011 @ 10½ "
(21) 7568 @ 3s. "	(33) 4076 @ 10¾ "
(22) 8543 @ 3¾ "	(34) 3687 @ 11½ "
(23) 2758 @ 4¼ "	(35) 2734 @ 11¾ "
(24) 5623 @ 4½ "	(36) 3016 @ 11¾ "

When the price is shillings.

### RULE.

Multiply by the shillings, and divide by 20 ; or if the shillings be the aliquot part of a pound, divide by the aliquot part.

467 @ 7s.	684 @ 10s.	763 @ 5s.
467	10s. = ½ ) 684	5 = ¼ ) 763
7		
<hr/>	<hr/>	<hr/>
20) 326 9	£342 Ans.	£190 15
<hr/>		<hr/>
£163 9 Ans.		

When the price is an even number of shillings, the operation may be shortened by multiplying by half the number of shillings, doubling the units place for shillings.

What is the price of	What is the cost of	
468 yds. @ 8s. per yd.	967 yds. @ 14s. per yd.	1765 @ 18s.
Yards.	Yards.	Yards.
468 @ 8s.	967 @ 14s.	1765 @ 18s.
4	7	9
<hr/>	<hr/>	<hr/>
£187 4 Ans.	£676 18 Ans.	£1588 10 Ans.
<hr/>	<hr/>	<hr/>

(37) 6428 @ 2s.	(43) 3604 @ 8s.	(49) 7617 @ 14s.
(38) 9460 @ 3s.	(44) 8756 @ 9s.	(50) 2016 @ 15s.
(39) 7568 @ 4s.	(45) 3601 @ 10s.	(51) 3637 @ 16s.
(40) 3675 @ 5s.	(46) 5768 @ 11s.	(52) 1209 @ 17s.
(41) 4103 @ 6s.	(47) 2104 @ 12s.	(53) 4123 @ 18s.
(42) 2602 @ 7s.	(48) 6018 @ 13s.	(54) 7641 @ 19s.

When the price is shillings and pence.

**RULE.**

If the price be the aliquot part of a pound, divide by the aliquot part. If it be not an aliquot part, multiply by the shillings, and take aliquot parts of a shilling for the pence and farthings.

964 lbs. of tea. @ 6s. 8d. per lb.

$$6s. 8d. = \frac{1}{3}) 964$$

$$\underline{\underline{\pounds 321 \quad 6 \quad 8 \text{ Ans.}}}$$

268 yds of cloth, @ 7s. 6½d. per yd.

$$6d = \frac{1}{2}) 268$$

$$\underline{\underline{1876}}$$

$$\frac{1}{2}d. = \frac{1}{12} \begin{array}{r} 134 \\ 11 \quad 2 \end{array}$$

$$20) 202 \quad 1 \quad 2$$

$$\underline{\underline{\pounds 101 \quad 1 \quad 2 \text{ Ans.}}}$$

			s.	d.
(55)	3468	@	3	6
(56)	4976	@	4	7
(57)	5048	@	6	3½
(58)	3162	@	5	8½
(59)	7643	@	8	7
(60)	5736	@	9	4½
(61)	3987	@	9	8½
(62)	6426	@	10	6½
(63)	8650	@	11	9½

			s.	d.
(64)	1201	@	12	10
(65)	2768	@	13	7½
(66)	6475	@	14	9½
(67)	4678	@	15	7
(68)	9621	@	16	9½
(69)	4103	@	17	8½
(70)	2464	@	18	4½
(71)	3102	@	18	5½
(72)	6765	@	19	7½

When the price is pounds, shillings, pence, and farthings

**RULE.**

Multiply by the pounds, and take aliquot parts for the rest.

What is the value of 248 chests of tea, @ 9l. 17s. 8d. per chest?

$$\begin{array}{r} \text{s.} \quad \text{d.} \\ 10 \quad 0 = \frac{1}{2}) 248 \\ \underline{\quad 9 \quad} \end{array}$$

$$\text{or thus, } \begin{array}{r} \text{s.} \quad \text{d.} \\ 10 \quad 0 = \frac{1}{2}) 248 \\ \underline{\quad 9 \quad} \end{array}$$

$$\begin{array}{r} 2232 \\ 5 \quad 0 = \frac{1}{2} \quad 124 \\ 2 \quad 6 = \frac{1}{4} \quad 62 \\ 0 \quad 2 = \frac{1}{12} \quad 2 \quad 1 \quad 4 \\ \underline{\underline{\pounds 2451 \quad 1 \quad 4 \text{ Ans.}}} \end{array}$$

$$\begin{array}{r} 2232 \\ 6 \quad 8 = \frac{1}{2} \quad 124 \\ 1 \quad 0 = \frac{1}{12} \quad 82 \quad 13 \quad 4 \\ \underline{\quad 12 \quad 8 \quad 0 \quad} \\ \underline{\underline{\pounds 2451 \quad 1 \quad 4 \text{ Ans.}}} \end{array}$$

			£	s.	d.				£	s.	d.
(73)	7964	@	7	9	6	(81)	7204	@	12	16	7
(74)	4679	@	8	17	8	(82)	4121	@	13	14	8
(75)	8742	@	4	16	5½	(83)	3145	@	14	17	9½
(76)	2598	@	9	12	8½	(84)	6876	@	15	19	7
(77)	8764	@	10	17	6½	(85)	9684	@	16	18	6½
(78)	2687	@	12	14	7	(86)	7780	@	17	13	4
(79)	9648	@	8	11	4½	(87)	4627	@	18	14	5
(80)	2784	@	11	10	2						

When both the quantity and price are of several denominations.

### RULE.

Multiply the price by the highest term in the quantity, and take parts for the rest of the quantity.

### EXAMPLES.

What is the price of 3 cwt. 2 qrs. 7 lbs. of sugar at 3*l*. 6*s*. 8*d*. per cwt. ?

	£	s.	d.
2 qrs. = ½ )	3	6	8
			3
	10	0	0
7 lb. = ⅙ )	1	13	4
	0	4	2
	£11	17	6.

What is the value of 25 cwt. 2 qrs. 14 lbs. at 3*l*. 17*s*. 6*d*. per cwt. ?

	£	s.	d.
2 qrs. = ½ )	3	17	6
			5 × £ = 25
	19	7	6
			5
	96	17	6
14 lb. = ⅙ )	1	18	9
	0	9	8½
	£99	5	11½

	cwt.	qrs.	lbs.	£	s.	d.		cwt.	qrs.	lbs.	£	s.	d.		
(88)	24	2	7	@	2	16	7	(94)	35	1	8	@	6	10	6
(89)	14	1	8	@	3	14	6	(95)	36	2	7	@	4	12	8½
(90)	7	3	6	@	4	15	8	(96)	40	3	9	@	9	16	1½
(91)	16	2	18	@	5	14	9	(97)	42	2	16	@	8	14	7
(92)	27	1	16	@	6	13	2	(98)	45	1	14	@	9	15	6½
(93)	32	2	14	@	7	19	8	(99)	48	2	4	@	4	17	8

When the quantity contains a fraction.

### RULE.

Work for the whole number by the preceding rules, and to the result add the ⅓ or ⅔ or ¾, or whatever other fraction of the price may be in the given quantity.

The sum to be added may be obtained by multiplying the price by the upper figure of the fraction, and dividing by the under figure.

## EXAMPLE.

What is the value of  $246\frac{1}{3}$  cwt. of cheese at  $3l. 10s. 6d.$  per cwt.?

$$\begin{array}{r}
 10s. = \frac{1}{3} \quad 246 \\
 \hline
 \quad \quad \quad 3 \\
 6d. = \frac{1}{4} \quad 123 \\
 \hline
 \quad \quad \quad 6 \quad 3 \\
 \frac{1}{2} = \quad \quad 1 \quad 8 \quad 2\frac{1}{2} \quad \frac{1}{2} \\
 \hline
 \underline{\underline{\pounds 368 \quad 11 \quad 2\frac{1}{2} \quad \frac{1}{2}}}
 \end{array}$$

The value of the fraction may be found thus:—

$$\begin{array}{r}
 \pounds \quad s. \quad d. \\
 3 \quad 10 \quad 6 \\
 \hline
 2 \\
 5) \quad 7 \quad 1 \quad 0 \\
 \hline
 \pounds 1 \quad 8 \quad 2 \quad - \quad \frac{1}{2}
 \end{array}$$

			£	s.	d.				£	s.	d.
(100)	4786½	@	3	10	6	(106)	7426½	@	6	15	8
(101)	7641½	@	4	9	7	(107)	3278½	@	2	12	6
(102)	8469½	@	0	8	6	(108)	4625½	@	0	14	7½
(103)	4210½	@	0	5	7½	(109)	2010½	@	6	16	9
(104)	8659½	@	0	7	11½	(110)	3607½	@	8	19	8½
(105)	4286½	@	9	12	6½	(111)	1243½	@	3	17	7

Wages.—Having the wages per day, to find the amount per year.

## RULE.

Take so many pounds, half-pounds and 5 pennies sterling, as there are pence per day.

## EXAMPLE.

What are the yearly wages at  $5d.$  per day?

$$\begin{array}{r}
 \pounds \quad s. \quad d. \\
 1 \quad 10 \quad 5 \\
 \hline
 5 \text{ the number of pence per day.} \\
 \hline
 \pounds 7 \quad 12 \quad 1 \text{ the wages per year.} \\
 \underline{\underline{\hspace{1.5cm}}}
 \end{array}$$

(112)	@	3d. per day.	(115)	@	14d. per day.
(113)	@	7d. "	(116)	@	2s. 3d. "
(114)	@	9d. "	(117)	@	8½d. "

## BILLS OF PARCELS.

No. 1.

Mr. John Franks

London, 7th Dec., 1861.

Bought of RICHARD GREEN.

			s.	d.	
15 yards of fine broad cloth	@	13	6		per yard
24 " superfine "	"	18	9		"
27 " yard wide "	"	8	4		"
16 " drugget "	"	6	8		"
12 " serge "	"	2	10		"
32 " shalloon "	"	1	8		"

£

No. 2.

Mr. Isaac Freeman

Greenwich, 8th August, 1861.

Bought of THOMAS ALGAR.

			s.	d.	
9 pairs of worsted hose	@	4	6		per pair
6 " silk "	"	15	9		"
17 " thread "	"	5	4		"
23 " cotton "	"	4	10		"
14 " yarn "	"	2	4		"
18 " { women's silk }	"	4	2		"
19 " { gloves }	"	1	7½		"
19 " flannel "	"	1	7½		"

£

No. 3.

Mr. Philip Brown

Woolwich, 9th Jan., 1862.

Bought of R. GRISBROOK &amp; Co.

			s.	d.	
40 ells of dowlas	@	1	6		per ell.
34 " diaper "	"	1	4½		"
37 " Holland "	"	5	8		"
29 yards of linen	"	2	4		per yard.
17½ " muslin "	"	7	2½		"
13½ " cambric "	"	10	6		"
54 " printed calico "	"	1	2½		"

£

# BILLS OF FARE

75

4. Honble. Miss Halvern

London, 7th Nov. 1861

Bought of Thomas & Co.

9½ yards of silk	£	12	4	per yard
18 " flowered do.	£	15	6	"
11½ " lining	"	6	10	"
14 " lace	"	11	8	"
12½ " satin	"	10	6	"
11½ " velvet	"	18	0	"

Mr. William May

London, 18th Dec. 1861

Bought of Thomas & Co.

10 gallons of whisky	£	6	4	per gal.
10 " rum	"	6	8	"
10 " Holland	"	8	9	"

John Lamb

London, 7th Jan. 1862

Bought of Thomas & Co.

10 lb of currants	£	6	4	per lb.
10 " Malaga raisins	"	6	8	"
10 " raisins of the sun	"	6	8	"
10 " rice	"	6	8	"
10 " pepper	"	1	6	"
10 lb of sugar, weight 32½ lb.	"	6	8	"
10 " cloves	"	6	8	"

## QUESTIONS FOR THE PUPIL

Notice, and why is it so called?

Difference between "ARITHMETIC" and "ALGEBRA"

Why number 50000?

Why is less than a penny?

Why is less than a penny?

Why number of articles when

12

weigh-  
sual?  
eighing  
red?

the price of each is an even or odd number of shillings, and less than 20?

What is the rule when the price is shillings and pence?

When it is pounds, shillings, pence, and farthings?

What is the rule when both the quantity and the price are of several denominations?

How do we find the price when the quantity contains a fraction?

### TARE AND TRET.

Gross Weight means the weight both of goods and package, whether these packages are barrels, boxes, or sacks.

Tare is an allowance made to the purchaser for the weight of the package.

Suttle is the weight which remains after deducting the tare.

Tret is an allowance of 4 lbs. on every 104 lbs. of goods for waste or  $\frac{1}{4}$  part of the whole weight of the goods liable to waste after the tare has been deducted.

Cloff is an allowance of 2 lbs. in every 3 cwt. after both tare and tret have been deducted.

What remains after making all deductions is called the Net or Neat weight.

Different allowances are made in different places and for different goods.

When an allowance is made for the tare per package, barrel, box, or sack.

#### EXAMPLE.

What is the net weight of 4 hogsheads of sugar, each weighing 13 cwt. 3 qrs. 14 lbs., the tare being 1 qr. 10 lbs. per hhd.?

cwt.	qrs.	lbs.		cwt.	qrs.	lbs.
13	3	14	$\times 4 =$	55	2	0 gross
	1	10	$\times 4 =$	1	1	12 tare
Answer				54	0	16 net weight

1. What is the net weight of 9 chests of tea, each weighing 5 cwt. 2 qrs. 19 lbs., tare 18 lbs. per chest?

2. What is the net weight of 6 chests of tea, each weighing 1 cwt. 3 qrs. 9 lbs., tare 18 lbs. per chest?

When the tare is so much per cwt.

## EXAMPLE.

Gross weight 173 cwt. 3 qrs. 17 lbs., tare 16 lbs. per cwt.: what is the net weight?

## RULE.

Divide the gross weight, 173 cwt. 3 qrs. 17 lbs., by the aliquot part of a cwt.: thus, 14 lbs. is  $\frac{1}{8}$  of a cwt.; again 2 lbs. is the  $\frac{1}{4}$  of 14 lbs.: add the quotient thus obtained together, and subtract this from the gross weight; the difference, 149 cwt. 8 lbs., is the net weight.

lbs.	cwt.	qrs.	lbs.
14 = $\frac{1}{8}$	173	3	17
2 = $\frac{1}{4}$	21	2	26 — 5
	3	0	11 — 5
	24	3	9 — 10
Net weight	149	0	8

3. What is the weight of 7 hhds. of sugar, each 6 cwt. 3 qrs. 14 lbs. gross, tare 12 lbs. per cwt.?  
 4. What is the net weight of 8 hhds. of tobacco, each 3 cwt. 2 qrs. gross, tare 18 lbs. per cwt.?  
 5. The gross weight of 50 casks of butter is 202 cwt. 2 qrs. 12 lbs., tare 15 lbs. per cwt., what is the net weight?

When allowance is to be made both for tare and tret.

## EXAMPLE.

What is the net weight of 4 cwt. 2 qrs. 14 lbs. gross, tare 14 lbs. per cwt., tret as allowed?

## RULE.

Find the tare by the preceding rule, and subtract it from the gross; divide the remainder, oruttle as it is called, by 26 (26 being the  $\frac{1}{4}$  of 104) for the tret; this when subtracted from theuttle, leaves the net weight required.

cwt.	qrs.	lbs.
4	2	14 gross
	2	8 tare
$\frac{1}{26}$ 4	0	6 subtle
		17 tret
	3	3 17 net

6. What is the net weight of 9 hhds. of tobacco, each weighing 5 cwt. 2 qrs. 12 lbs., tare 96 lbs. per hhd., tret as usual?  
 7. What is the net weight of 6 chests of tea, each weighing 1 cwt. 3 qrs. 9 lbs., tare 18 lbs. per chest, tret as allowed?



8. The gross weight of 24 barrels of rice is 67 cwt. 18 lbs.; tare 1 qr. 12 lbs. per barrel, tret as usual; the net weight?

When the tare, tret, and cloff are allowed.

#### EXAMPLE.

What is the net weight of 4 cwt. 2 qrs. 14 lbs. gross 14 lbs. per cwt., tret as allowed, cloff as allowed?

#### RULE.

Take the tare and the tret from the gross as before; divide the remainder or suttie by 168 (168 being the half of 3 cwt. or 336 lbs.); this being subtracted leaves the net weight. The cloff may also be obtained by multiplying the cwt. of the tret suttie by 2, and dividing by 3, reckoning the quotient as pounds, thus:  $2 \times 3 = 6 \div 3 = 2$  lbs.

$$\begin{array}{r}
 \text{cwt. qrs. lbs.} \\
 14 = \frac{1}{8} ) \begin{array}{r} 4 \quad 2 \quad 14 \text{ gr} \\ \quad \quad 2 \quad 8 \text{ tar} \end{array} \\
 \hline
 \frac{1}{8} ) \begin{array}{r} 4 \quad 0 \quad 6 \\ \quad \quad \quad 17 \text{ tre} \end{array} \\
 \hline
 168 ) \begin{array}{r} 3 \quad 3 \quad 17 \text{ su} \\ \quad \quad \quad 2 \text{ clo} \end{array} \\
 \hline
 \underline{\quad \quad 3 \quad 3 \quad 15 \text{ ne}}
 \end{array}$$

9. What is the net weight of 8 hhds. of sugar, each ing 6 cwt. 3 qrs. 14 lbs.; tare 12 lbs. per cwt., tret as usual?

10. What is the net weight of 8 hhds. of tobacco 3 cwt. 2 qrs. gross; tare 18 lbs. per cwt., tret and allowed?

11. The gross weight of 50 casks of butter is 24 2 qrs. 12 lbs.; tare 15 lbs. per cwt., tret and cloff as a what is the net weight?

12. What is the net weight of 24 hhds., weighing 1 cwt. 2 qrs. 18 lbs.; tare 2 qrs. 18 lbs. per hhd., tret as

#### QUESTIONS FOR THE PUPIL.

What is the gross weight?

What is tare?

What is suttie?

What is tret?

What is cloff?

What is the net weight?

Are the allowances made always the same?

## INTEREST.

Interest is the price which is allowed for the use of money. It depends on the plenty or scarcity of the latter, and the risk which is run in lending it.

Interest is either Simple, or Compound. It is simple when the interest due is not added to the sum lent, so as to bear interest.

It is compound when, after certain periods, it is made to bear interest, being added to the sum, and considered as a part of it.

The money lent is called the principal. The sum allowed for each hundred pounds "per annum" (for a year) is called the "rate per cent." (per 100*l.*) The amount is the sum of the principal and the interest due.

To find the interest of any sum for one or more years at any rate per cent.

## RULE.

Multiply the sum by the rate per cent. and divide the product by 100; the quotient is the interest for one year. If more than one, multiply the interest for one year by the number of years.

## EXAMPLE.

What is the interest of 536*l.* 8*s.* 6*d.* for 3 years at 4 per cent. per annum?

£	s.	d.
536	8	6
		4
21,45	14	0
	20	
9,14		
	12	
1,68		
	4	
2,72		

## SECTION II.

£	s.	d.	
21	9	1½	interest for one year
<hr/>			
£ 64	7	4½	interest for three years.

To find the interest of a given sum for years, months, and days.

## RULE.

Having found the interest for the years as before direct take aliquot parts of the interest of one year for the months and days.

## EXAMPLE.

What is the interest of 637*l.* 12*s.* 6*d.* for 4 years 7 months and 18 days at 4½ per-cent. per annum?

	£	s.	d.	
4½ ) 637	12	6		
			4½	
	2550	10	0	
	318	16	3	
	<hr/>			
	28,69	6	3	
		20		
	<hr/>			
	18,86			
		12		
	<hr/>			
	10,35			
		4		
	<hr/>			
	1,40			
	<hr/>			
6 months = ½	28	13	10½	interest for one year.
			4	
	<hr/>			
	114	15	9	interest for 4 years.
1 month = ⅙	14	6	11 - ⅙	6 months.
15 days = ¼	2	7	9¾ - ¼	1 month.
3 " = ⅓	1	3	10½ - ⅓	15 days.
	0	4	9½ - ⅓	3 days.
	<hr/>			
	£ 132	19	1½	interest for the whole time.

NOTE.—12 months are reckoned as a year and 30 days a month; here 52 weeks are reckoned as a year.

To find the interest for days at 5 per cent.

RULE.

Multiply the principal by the number of days, and divide the product by 7300.

To find the interest for days at any other rate. Find the interest at 5 per cent. and take part of this for the remainder.

EXERCISES.

1. What is the interest of 267*l.* for 4 years at 5 per cent. per annum?

2. What is the interest of 964*l.* 15*s.* for 6 years at 4 per cent. per annum?

3. What is the interest of 2368*l.* 10*s.* for  $4\frac{1}{2}$  years at  $4\frac{1}{2}$  per cent. per annum?

4. What is the interest of 768*l.* 9*s.* 6*d.* for  $9\frac{1}{2}$  years at  $3\frac{1}{4}$  per cent. per annum?

5. What is the amount of 379*l.* 16*s.* for  $9\frac{1}{2}$  years at  $4\frac{1}{2}$  per cent. per annum?

6. What is the amount of 3786*l.* 14*s.* for 17 years at  $4\frac{2}{5}$  per cent. per annum?

7. What is the interest of 859*l.* 13*s.* for 6 years, 8 weeks, and 4 days at  $2\frac{1}{2}$  per cent. per annum?

8. What is the interest of 7462*l.* 13*s.* for 9 years and 6 weeks at  $3\frac{1}{2}$  per cent. per annum?

9. What is the amount of 9864*l.* 17*s.* 9*d.* for 10 years, 7 weeks, and 4 days at  $4\frac{3}{8}$  per cent. per annum?

10. Required the interest of 460*l.* 12*s.* 6*d.* for 2 years and 4 months at 5 per cent. per annum.

11. What is the interest of 723*l.* 15*s.* 6*d.* for  $3\frac{1}{2}$  years at  $4\frac{3}{4}$  per cent. per annum?

12. Required the amount of 246*l.* 15*s.* for 3 years 6 weeks and 4 days at  $2\frac{1}{2}$  per cent. per annum.

To find the interest of money left after one or more payments.

RULE.

If the interest is paid by days, multiply the sum by the number of days which have elapsed before any payment was made. Subtract the first payment, and multiply the remainder by the number of days which passed between the first and second payments. Subtract the second payment, and multiply



at 5 per cent. I owe at the end of the year 105*l*. If I wish to pay off the debt, I pay 105*l*. If I wish merely to pay the interest, I pay 5*l*., and still owe 100*l*. If, however, I do neither, it is clear that at the end of the second year I must pay interest, not upon 100*l*. but upon 105*l*.

## EXAMPLE.

What is the compound interest of 240*l*. 10*s*. for 3 years at 5 per cent. per annum?

	£	s.	d.	
5 = $\frac{1}{20}$ )	240	10	0	1st year's principal
Add	12	6	6	1st year's interest
<hr/>				
$\frac{1}{20}$ )	252	10	6	2nd year's principal
Add	12	12	6 $\frac{1}{2}$	2nd year's interest
<hr/>				
$\frac{1}{20}$ )	265	3	0 $\frac{1}{2}$	3rd year's principal
Add	13	5	1 $\frac{3}{4}$	3rd year's interest
<hr/>				
	278	8	2	amount in 3 years
Subtract	240	10	0	principal
<hr/>				
	£	37	18	2 compound interest for 3 years.

## RULE.

Find the interest upon the principal for 1 year at 5 per cent., viz. 12*l*. 0*s*. 6*d*., and add it to the principal. At the beginning of the second year the principal is 252*l*. 10*s*. 6*d*.; find the interest upon this for 1 year, at 5 per cent., add it; and so on for any number of years. 278*l*. 8*s*. 2*d*. is what 240*l*. 10*s*. amounts to in 3 years. The compound interest is found by taking the original principal, 240*l*. 10*s*. from the amount in 3 years, 278*l*. 8*s*. 2*d*.; the remainder, 37*l*. 18*s*. 2*d*., is the compound interest on 240*l*. 10*s*. for 3 years.

1. Required the interest on 204*l*. for 3 years at 5 per cent. compound interest.

2. Required the amount of 640*l*. for 4 years at 3 per cent. compound interest.

3. What is the compound interest on 678*l*. 16*s*. for 6 years at  $3\frac{1}{2}$  per cent. per annum?

4. What is the compound interest on 786*l*. 10*s*. for 6 years at  $4\frac{1}{2}$  per cent. per annum?

## QUESTIONS FOR THE PUPIL.

What is interest?

What is the difference between simple and compound interest?

What are the principal, rate, and amount?

How is the simple interest for one or more years found?

How is the interest found when the time consists of years, months, and days?

How is the simple interest for days at 5 per cent. found?

How is the simple interest for days at any other rate found?

How is the interest of money left after one or more payments found?

How are the amount, and compound interest found when the principal, rate, and time are given?

## DISCOUNT.

Discount is an allowance for payment of money before it is due. It is the difference between a sum and its present value.

## EXAMPLE.

What is the discount on 250*l.* due six months hence at 5 per cent.?

$$\begin{array}{rcl}
 \text{£} \text{ s.} & & \text{£} \text{ s.} \\
 \text{£}100 + 2 \text{ } 10 & = & 102 \text{ } 10 \\
 & & \underline{20} \\
 & & 2050 \\
 & & \underline{\hspace{1cm}} \\
 & & \text{£}6 \text{ } 1 \text{ } 11\frac{1}{2}
 \end{array}
 \quad
 \begin{array}{rcl}
 \text{£} & & \text{£} \text{ s.} \\
 250 & : : & 2 \text{ } 10 \\
 & & \underline{20} \\
 & & 50 \\
 & & \underline{\hspace{1cm}} \\
 & & 50
 \end{array}$$

## RULE.

As 100*l.* with interest for the given rate and time added to it is to the sum or debt, so is the interest of 100*l.* for the given rate and time to the discount.

1. What is the present value of 640*l.* due 2 years hence, at 5 per cent.?

2. What is the discount on 370*l.* due 100 days hence, at  $\frac{1}{2}$  per cent.?

3. What is the discount on 246*l.* 16*s.*, from March 26 to June 23, both days included, at 3½ per cent.?

QUESTIONS FOR THE PUPIL.

What is discount?

What is the present worth of any sum?

How is discount calculated?

COMMISSION, BROKERAGE, &c.

Commission is an allowance given to an agent or factor, for buying or selling goods, negotiating bills, &c.

Brokerage is an allowance to a broker for procuring sales, transfers of property, &c.

Insurance is an allowance, called premium, given to persons who engage to make good the loss of ships, merchandise, houses, &c., that may be lost or damaged by storms, fires, &c.

To compute commission, &c.

RULE.

As 100*l.* is to the rate of commission, so is the given sum to the corresponding commission.

EXAMPLE.

What will be the commission on goods worth 437*l.* 5*s.* 2*d.* at 4 per cent.?

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ \text{£100} : \text{£4} :: \text{£437 } 5\text{s. } 2\text{d.} : 4 \times \frac{\text{£437 } 5\text{s. } 2\text{d.}}{100} = 17 \quad 9 \quad 9\frac{1}{2} \end{array}$$

To find what insurance must be paid so that, if the goods are lost, both their value and the insurance paid may be recovered.

RULE.

As 100*l.* minus the rate per cent. is to 100*l.* so is the value of the goods insured to the required insurance.

EXAMPLE.

What sum must I insure, that if goods worth 400*l.* are lost,



I may receive both their value and the insurance paid, the latter being at the rate of .5 per cent.?

$$\begin{array}{rcccl} & & & \text{£} & \text{s.} & \text{d.} \\ \text{£95} & : & \text{£100} & : : & \text{£400} & : & \frac{\text{£100} \times \text{£400}}{95} = 421 & 1 & 0\frac{1}{2} \end{array}$$

1. What is the commission on 1243*l.* 19*s.* at  $\frac{1}{2}$  per cent.?
2. What is the brokerage on 3964*l.* 14*s.* at  $1\frac{1}{2}$  per cent.?
3. What is the brokerage on 467*l.* at  $\frac{2}{3}$  per cent.?
4. I employed an agent to sell a quantity of goods; having agreed to give him  $\frac{2}{3}$  per cent. upon the sales, the goods having been sold for 7648*l.*; how much am I to pay him?
5. What premium must be paid for insuring a house for 7648*l.* at  $2\frac{1}{4}$  per cent.?
6. What is the insurance on 6968*l.* for two years at  $4\frac{1}{2}$  per cent.?
7. What is the expense of insuring a ship and cargo at 3*l.* 15*s.* per cent., the ship being worth 2450*l.* and the cargo worth 4768*l.*?
8. At  $4\frac{1}{2}$  per cent. how much must be insured on goods worth 768*l.*, so that in case of loss the owner may receive the value of the goods and the premium?

### QUESTIONS FOR THE PUPIL.

- What is commission?  
 What is insurance?  
 What is brokerage?  
 How are commission, insurance, &c., calculated?  
 How is insurance calculated, so that both the insurance and value of the goods may be received if the latter are lost?

### PROMISCUOUS EXERCISES.

1. A draper sells 10 dozen umbrellas, all at one price, for 20 guineas: how much does he receive for 70 of them?
2. When sound travels 1 mile 5 furlongs 140 yards in 1 seconds, what is its velocity per minute?
3. If a house rated at 15*l.* rent pay 18*s.*  $1\frac{1}{2}$ *d.*, at what rent is a house rated which pays 1*l.* 4*s.* 2*d.*?
4. If an allowance of 2 lbs. 10 oz. to each man per day will make a certain quantity of provisions serve a ship's crew

or 35 days, how long would the same provisions last at an allowance of 1 lb. 4 oz.?

5. I bought 112 gals. 2 qts. 1 pt. for 102*l.*; for what must I sell 99 gals. 1 qt. 1 pt. of it, so as not to be a loser?

6. A bankrupt owes his creditors 2960*l.*, and can pay them 12*s.* 6*d.* per *£*; how much would a person receive to whom he owes 64*l.* 18*s.* 4*d.*?

7. If 10*l.* 12*s.* 11*d.* be the wages of 14 men and 3 boys; how many persons will 11*l.* 10*s.* 5*d.* pay, admitting that a man earns 5 times as much as a boy?

8. The hair-spring of a watch weighs about the tenth of a grain, and is sold, it is said, for about ten shillings; what would be the price of a pound of crude iron, costing one halfpenny, made into steel, and then into hair-springs—supposing that after deducting waste there are obtained from the iron 7000 grains of steel?

9. A wall is to be built of the height of 27 feet, and 9 feet high of it are built by 12 men in 6 days; how many men must be employed to finish the remainder in 4 days?

10. When the mercury in the barometer stands at a height of 30 inches, the pressure of the air on every square inch of surface is 15 lbs.; what will be the pressure on the human body, supposing its whole surface to be 14 square feet, and that the barometer stands at 31 inches?

11. What is the cost of 273½ articles at 2*s.* 6*d.* each?

12. Find the value of 530¾ lbs. of spice at 14*s.* per lb.

13. What is the value of 762½ cwt. at 1*l.* 12*s.* 6*d.* per cwt.?

14. 147 oz. 14 dwts. 14 grs. at 7*s.* 6*d.* per ounce?

15. What is the net weight of 19 chests, each weighing 2 cwt. 13 lbs.; tare 14 lbs. per chest, tret as allowed?

16. What is the value of the net weight of 3 hhds. of tobacco, each weighing 4 cwt. 2 qrs. 12 lbs. gross at 7*l.* 10*s.* 6*d.* per cwt., allowing 7 lbs. per cwt. for tare, tret as usual, and cloff 2 lbs. per hhd.?

17. Bought 5 packs of wool, weighing: No. 1, 4 cwt. 2 qrs. 15 lbs.; No. 2, 4 cwt. 2 qrs.; No. 3, 3 cwt. 3 qrs. 21 lbs.; No. 4, 3 cwt. 3 qrs. 14 lbs.; No. 5, 4 cwt. 14 lbs.; tare 28 lbs. per pack, tret 8 lbs. for every 20 stone; and at 11*s.* 6*d.* per stone; what is the price of the whole?

18. What is the interest of 344*l.* 17*s.* 6*d.* for one year at 6 per cent.?

19. What is the interest of 968*l.* 5*s.* for one year at 5*l.* 14*s.* 6*d.* per cent.?

20. What is the interest of 1090*l.* for 1 year and 5 months at 6 per cent.?

21. What is the interest of 279*l.* 11*s.* for 7 $\frac{1}{2}$  months at  $\frac{1}{2}$  per cent.?

22. A merchant borrows 250*l.* at 8 per cent. for 2 years, with condition to pay before that time as much of the principal as he pleases. At the expiration of 9 months he pays 80*l.* and 6 months after 70*l.*, leaving the remainder for the entire term of 2 years; how much interest and principal has he to pay at the end of that time?

23. I borrow 300*l.* at 6 per cent. for 18 months, with condition to pay as much of the principal before the time as I please. In 3 months I pay 60*l.*, 4 months after 100*l.*, and 5 months after that 75*l.* How much principal and interest have I to pay at the end of 18 months?

24. What is the amount and compound interest of 142*l.* for 8 years at 3 per cent. half-yearly?

25. What ready money now will pay a debt of 200*l.* to be due 127 days hence, discounting at 6 per cent.?

26. Bought goods to the value of 35*l.* 13*s.* 8*d.* to be paid in 294 days: what ready money are they now worth, 6 per cent per annum discount being allowed?

27. How much is the commission on goods worth 971*l.* 14*s.* 7*d.* at 5*s.* per cent.?

28. How much is to be insured at 5 per cent. on goods worth 900*l.*, so that, in case of loss, not only the value of the goods, but the premium of insurance also may be repaid?

## SECTION III.

### VULGAR FRACTIONS.

A FRACTION is a part, or a number of parts, of a unit: as  $\frac{1}{4}$  *l.*, one-fourth of one pound;  $\frac{2}{3}$  mile, three-fifths of one mile.

The lower number or term represents the number of equal parts the unit is divided into, and is called the denominator.

The upper number or term shows how many of those parts are taken to form the fraction, and is called the numerator.

Thus, if an orange be cut into six equal parts, and one of them be taken,  $\frac{1}{6}$  of the orange will be taken : the denominator of the fraction being 6, and the numerator 1. If two of the parts be taken,  $\frac{2}{6}$ , that is  $\frac{1}{3}$  of the orange will be taken. If 3 of the parts be taken,  $\frac{3}{6}$  or  $\frac{1}{2}$  of the orange will be taken. If 4 of the parts be taken,  $\frac{4}{6}$  or  $\frac{2}{3}$  of the orange will be taken. If 5 of the parts be taken,  $\frac{5}{6}$  of the orange will be taken. If 6 of the parts be taken,  $\frac{6}{6}$ , that is, the whole of the orange, will be taken.

In considering this case it is evident, that if the denominator remains constant, the fraction will be larger or smaller according as the numerator is larger or smaller ; that if the numerator is constant, the fraction is larger when the denominator is smaller ; that when the denominator and numerator are equal, the fraction is  $= 1$  ; and that the value of a fraction is not changed by multiplying or dividing both its terms by the same number.

A proper fraction is one which has its numerator less than its denominator, as  $\frac{1}{2}$ ,  $\frac{2}{3}$ ,  $\frac{4}{7}$ ,  $\frac{1^1}{11}$ ,  $\frac{3^2}{5}$ .

An improper fraction is one which has its numerator greater than its denominator, as  $\frac{3}{2}$ ,  $\frac{7}{4}$ ,  $\frac{8}{5}$ ,  $\frac{1^1}{3}$ .

A compound fraction is a fraction of a fraction, and is expressed by two or more fractions, as  $\frac{2}{3}$  of  $\frac{3}{4}$ , or  $\frac{1}{2}$  of  $\frac{2}{3}$  of  $\frac{4}{5}$ . It may be considered as the product of two or more single fractions.

A mixed number is a whole number with a fraction annexed, as  $2\frac{1}{2}$ ,  $4\frac{3}{5}$ ,  $16\frac{4}{5}$ .

A complex fraction has a fractional numerator or denominator ; but this denotes Division of Fractions. Thus  $\frac{\frac{2}{3}}{\frac{5}{6}}$ , two-

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thirds divided by five-sixths,  $1\frac{2}{3}$  eight divided by one and two-thirds.

Both proper and improper fractions are called simple. A fraction may be considered like a ratio, the numerator being the dividend, and the denominator the divisor : thus  $\frac{1}{6}$  of an orange is the same thing as 2 oranges.

Any whole number may be made a fraction of by writing a 1 under it for a denominator : for example, 6 may be made a fraction of by writing it thus  $\frac{6}{1}$ , or 10 thus  $\frac{10}{1}$ . The value of

a fraction is not altered by multiplying or dividing both the numerator and denominator, provided both be multiplied or divided by the same number.

A common measure (or divisor) is a number that will exactly divide both the terms. When it is the greatest number by which they are both divisible, it is called the greatest common measure.

To find the greatest common measure of two numbers.

#### RULE.

Divide the larger by the smaller: then the divisor by the remainder: next the preceding divisor by the new remainder: continue this process until nothing remains, and the last divisor will be the greatest common measure. If this be unity, the given numbers are prime to each other.

#### EXAMPLES.

1. Find the greatest common measure of 45 and 240.

$$\begin{array}{r} 45 \overline{) 240} \quad (5 \\ \underline{225} \\ 15 \overline{) 45} \quad (3 \\ \underline{45} \\ 0 \end{array}$$

Answer—15 is the G. C. M.

This rule depends upon the fact, that, if a number measure two others, it will also measure their sum, difference, and multiple of each.

2. Find the greatest common measure of 176 and 48.

$$\begin{array}{r} 48 \overline{) 176} \quad (3 \\ \underline{144} \\ 32 \overline{) 48} \quad (1 \\ \underline{32} \\ 16 \overline{) 32} \quad (2 \\ \underline{32} \\ 0 \end{array}$$

Answer—16 is the G. C. M.

*If there be more than two numbers, find the greatest common*

mon measure of two of them as above, and then that of that common measure, and the third number, and so on.

3. Find the greatest common measure of 176, 48, and 42.

As above, the G. C. M. of 176 and 48 is 16.

$$\begin{array}{r}
 16 \overline{) 42} \quad (2 \\
 \underline{32} \\
 10 \overline{) 16} \quad (1 \\
 \underline{10} \\
 6 \overline{) 10} \quad (1 \\
 \underline{6} \\
 4 \overline{) 6} \quad (1 \\
 \underline{4} \\
 2 \overline{) 4} \quad (2 \\
 \underline{4}
 \end{array}$$

Answer—2 is the G. C. M. of 176, 48, and 42.

### EXERCISES.

Find the greatest common measure of the following numbers—

- (1) 126 and 144.      (2) 344 and 3556.      (3) 14186 and 13667.  
 (4) 43365 and 44688.      (5) 11050 and 35581.      (6) 1624 and 140.

NOTE.—The following facts may be noticed.

An even number is divisible by 2.

A number is divisible by 4 when the tens and units are so; and by 8 when the hundreds, tens, and units are divisible by 8.

A number is a multiple of 3 or 9 when the sum of its digits is a multiple of 3 or of 9.

A 5 or 0 in the unit's place, admits of division by 5; one cipher admits of division by 10, two by 100, &c.

Any number which leaves nothing when the threes are cast out of the sum of its digits, is divisible by 3 at least; or which leaves nothing when the nines are cast out of the sum of its digits, is divisible by 9 at least.

If we divide two quantities by a number which we find by inspection will measure them, then divide the quotients by another number found in the same way, and proceed thus until we perceive that the resulting quotients are prime to each

other, the product of all the divisors will be the greatest common measure of the quantities.

To find the least common multiple of two quantities.

#### RULE.

Divide their product by their greatest common measure or, divide one of them by their greatest common measure, and multiply the quotient by the other—the result of either method will be the required least common multiple.

#### EXAMPLE.

Find the least common multiple of 72 and 84—12 is their greatest common measure.

$$\frac{72}{12} = 6, \text{ and } 6 \times 84 = 504 \text{ L.C.M.}$$

#### NOTE.

It is evident that if we multiply the given numbers together, their product will be a multiple of each by the other. It will be easy to find the smallest part of this product, which will still be their common multiple. Thus, to learn if, for example, its nineteenth part is such.

From what we have already seen, each of the factors of any product divided by any number and multiplied by the product of the other factors, is equal to the product of all the factors divided by the same number. Hence 72 and 84 being

the given numbers,  $\frac{72 \times 84}{19}$  (the nineteenth part of their product)  $= \frac{72}{19} \times 84$ , or  $72 \times \frac{84}{19}$ . Now if  $\frac{72}{19}$  and  $\frac{84}{19}$  be equivalent to integers,  $\frac{72}{19} \times 84$  will be a multiple of 84, and  $\frac{84}{19} \times 72$ , will be a multiple of 72; and  $\frac{72 \times 84}{19}$ ,  $\frac{72}{19} \times 84$ , and  $72 \times \frac{84}{19}$  will each be the common multiple of 72 and 84.

But unless 19 is a common measure of 72 and 84,  $\frac{72}{19}$  and  $\frac{84}{19}$  cannot be both equivalent to integers.

Therefore the quantity by which we divide the product of the given numbers, or one of them, before we multiply it by the other to obtain a new and less multiple of them, must be the common measure of both. And the multiple we obtain will, evidently, be the least, when the divisor we select is the greatest quantity we can use for the purpose,—that is, the greatest common measure of the given numbers.

It follows that the least common multiple of two numbers, prime to each other, is their product.

### EXERCISES.

Find the least common multiple of

- (1) 78 and 93.      (2) 19 and 72.      (3) 464320 and 18945.  
 (4) 638296 and 33888.      (5) 18996 and 29932.  
 (6) 260424 and 54423.

To find the least common multiple of three or more numbers.

### RULE.

Find the least common multiple of two of them, then of this common multiple, and a third; next of this last common multiple and a fourth, &c. The last common multiple found will be the least common multiple sought.

### EXAMPLE.

Find the least common multiple of 9, 3, and 27.

3 is the greatest common measure of 9 and 3, therefore

$\frac{9}{3} \times 3$ , or 9 is the least common multiple of 9 and 3.

9 is the greatest common measure of 9 and 27, therefore

$\frac{27}{9} \times 9$ , or 27, is the required least common multiple.

By this rule it is plain that 27 is the least common multiple of 9 and 27. But since 9 is a multiple of 3, 27, which is a multiple of 9, must also be a multiple of 3; 27, therefore, is a multiple of each of the given numbers, or their common multiple. It is likewise their least common multiple, because *none that is smaller can be common also to both 9 and 27,*



since they were found to have 27 as their least common multiple.

### EXERCISES.

Find the least common multiple of

- (7) 18, 17, and 43.    (8) 19, 78, 84, and 61.    (9) 51, 176832,  
29472, and 5862.    (10) 537842, 16819, 4367, and 2472.

### QUESTIONS FOR THE PUPIL.

How is the greatest common measure of two quantities found?

How is the greatest common measure of three or more quantities found?

How do we find the least common multiple of two numbers that are composite?

How is the least common multiple of two, of three, or more numbers found?

To change an improper fraction into a whole or mixed number.

### RULE:

Divide the numerator by the denominator, and if there be any remainder, write the denominator under it in the form of a fraction.

### EXAMPLE.

$$5 \overline{) 1367}$$

Reduce the improper fraction  $\frac{1367}{5}$  to a whole or mixed number.  $\underline{273} \frac{2}{5}$  Ans.

- |                              |  |
|------------------------------|--|
| (1) Reduce $\frac{7463}{3}$  | } to its equivalent whole or mixed number. |
| (2) Reduce $\frac{8463}{14}$ |  |
| (3) Reduce $\frac{9786}{43}$ |  |

- |   |                              |
|---|------------------------------|
| (4) Find the value of $\frac{64237}{698}$ | } in whole or mixed numbers. |
| (5) Find the value of $\frac{8363}{89}$   |                              |

Reduce the following fractions to whole or mixed numbers

- |                            |                            |                              |
|----------------------------|----------------------------|------------------------------|
| (6) $\frac{8586}{43}$      | (7) $\frac{7982}{680}$     | (8) $\frac{3643}{2104}$      |
| (9) $\frac{742633}{7687}$  | (10) $\frac{968760}{2780}$ | (11) $\frac{492001}{487600}$ |
| (12) $\frac{736201}{7036}$ | (13) $\frac{480010}{3684}$ | (14) $\frac{876246}{4968}$   |

To reduce a mixed number to an improper fraction.

### RULE.

Multiply the whole number by the denominator of the fraction; add the numerator, and under the product place the denominator.

### EXAMPLE.

Reduce the following number  $46\frac{2}{3}$  to an improper fraction.

$$\begin{array}{r} 46\frac{2}{3} \\ 5 \\ \hline 230 + 2 = 232 \\ \hline \end{array}$$

### EXERCISES.

Reduce the following mixed numbers to their equivalent proper fractions.

- |                          |                           |                           |                          |
|--------------------------|---------------------------|---------------------------|--------------------------|
| (15) $7\frac{1}{2}$      | (16) $8\frac{2}{3}$       | (17) $17\frac{4}{5}$      | (18) $9\frac{7}{9}$      |
| (19) $27\frac{4}{7}$     | (20) $647\frac{2}{15}$    | (21) $360\frac{10}{17}$   | (22) $976\frac{21}{30}$  |
| (23) $842\frac{17}{36}$  | (24) $684\frac{12}{27}$   | (25) $976\frac{24}{126}$  | (26) $843\frac{31}{421}$ |
| (27) $687\frac{28}{111}$ | (28) $769\frac{111}{234}$ | (29) $807\frac{101}{621}$ |                          |

To reduce a compound fraction to a simple fraction.

### RULE.

Multiply together all the numerators for a numerator, and the denominators for a denominator.

### EXAMPLE.

Reduce the compound fraction  $\frac{2}{3}$  of  $\frac{3}{7}$  to a simple fraction.

$$\frac{2 \times 3 \times 5}{3 \times 7 \times 1} = \frac{60}{21} \text{ Ans.}$$

Reduce the following compound fractions to their equivalent simple ones.

$$(30) \quad \frac{3}{6} \text{ of } \frac{2}{7} \text{ of } \frac{5}{7}$$

$$(31) \quad \frac{7}{9} \text{ of } \frac{3}{11} \text{ of } \frac{8}{15}$$

$$(32) \quad \frac{5}{13} \text{ of } \frac{17}{8} \text{ of } \frac{11}{29}$$

$$(33) \quad \frac{4}{9} \text{ of } \frac{8}{11} \text{ of } \frac{11}{12}$$

$$(34) \quad \frac{7}{17} \text{ of } \frac{8}{19} \text{ of } 7$$

$$(35) \quad \frac{17}{23} \text{ of } \frac{8}{9} \text{ of } \frac{3}{25} \text{ of } \frac{13}{19}$$

$$(36) \quad \frac{12}{37} \text{ of } \frac{1}{7} \text{ of } \frac{18}{33} \text{ of } 19\frac{1}{2}$$

$$(37) \quad \frac{11}{21} \text{ of } \frac{17}{36} \text{ of } \frac{135}{78} \text{ of } 24$$

$$(38) \quad \frac{8}{7} \text{ of } \frac{9}{17} \text{ of } \frac{29}{78} \text{ of } 32$$

$$(39) \quad \frac{7}{15} \text{ of } \frac{13}{19} \text{ of } \frac{21}{39} \text{ of } 27\frac{1}{2}$$

To reduce a fraction to its lowest terms.

#### RULE.

Divide the numerator and denominator by any number that will measure them; that is, that will divide them without a remainder. Do the same with the quotients as long as any number can be found to divide them.

Reduce  $\frac{144}{240}$  to its lowest terms.

Divide the fractions and the quotients by the figures placed above them.

$$\begin{array}{ccccccc} (2) & & (2) & & (3) & & (2) & & (2) \\ 144 & = & 72 & = & 36 & = & 12 & = & 6 \\ 240 & = & 120 & = & 60 & = & 20 & = & 10 \\ & & & & & & & & 5 \\ & & & & & & & & \frac{3}{5} \text{ the answer.} \end{array}$$

Or if a number be wished for that may bring the fraction to its lowest terms at once, divide the greater term by the less, and the divisor by the remainder; and so on, dividing each divisor by the last remainder till nothing remains. The last divisor is the number by which, if the numerator and denominator of the fraction be divided, the lowest term will be obtained.

Reduce  $\frac{144}{240}$  to its lowest terms.

The denominator of the fraction being greater, it is divided by the numerator. The former divisor, 144, is now to be divided by the remainder, 96; the remainder, 48 is now to be divided by the former divisor, 96. The last divisor, 48,

$$\begin{array}{r} 144 \overline{) 240} (1 \\ \underline{144} \phantom{0} \\ 96 \phantom{0} \\ 96 \overline{) 144} (1 \\ \underline{96} \phantom{0} \\ 48 \phantom{0} \\ 48 \overline{) 96} (2 \\ \underline{96} \phantom{0} \\ 0 \end{array}$$

number by which, if the numerator and denominator be divided, the lowest term will be obtained; thus  $48 \frac{1}{2} \frac{1}{3} = \frac{3}{5}$ , as in the former example.

Reduce the following numbers to the lowest terms.

$$(40) \frac{48}{272}$$

$$(44) \frac{740}{8675}$$

$$(48) \frac{55}{9900}$$

$$(41) \frac{46}{116}$$

$$(45) \frac{764}{5240}$$

$$(49) \frac{1245}{220}$$

$$(42) \frac{176}{484}$$

$$(46) \frac{644}{1728}$$

$$(50) \frac{1844}{1536}$$

$$(43) \frac{48}{160}$$

$$(47) \frac{825}{1920}$$

$$(51) \frac{140}{1664}$$

To reduce fractions to a common denominator.

# RULE.

Multiply each numerator by all the denominators, *except its own*, for a new numerator; and multiply all the denominators together for a new denominator.

Reduce  $\frac{2}{3}$ ,  $\frac{3}{5}$ , and  $\frac{4}{7}$  to a common denominator.

Here the first numerator, 2, is multiplied by 5 and 7, the denominators of the other fractions. Mark that it is not multiplied by its own denominator, 3. The same is done to the other numerators.

$$\left. \begin{array}{l} 2 \times 5 \times 7 = 70 \\ 3 \times 3 \times 7 = 63 \\ 4 \times 3 \times 5 = 60 \end{array} \right\} \text{numerators.}$$

$$3 \times 5 \times 7 = 105 \text{ com. denom.}$$

The answer then is  $\frac{70}{105}$ ,  $\frac{63}{105}$ ,  $\frac{60}{105}$ .

Reduce the following fractions to others having a common denominator.

$$(52) \frac{3}{4}, \frac{2}{3}, \text{ and } \frac{4}{7}$$

$$(53) \frac{5}{9}, \frac{7}{8}, \text{ and } \frac{6}{9}$$

$$(54) \frac{9}{11}, \frac{7}{18}, \text{ and } \frac{12}{19}$$

$$(55) \frac{18}{16}, \frac{11}{28}, \text{ and } \frac{18}{27}$$

$$(56) \frac{17}{24}, \frac{19}{26}, \frac{15}{42}, \text{ and } \frac{13}{17}$$

$$(57) \frac{21}{47}, \frac{18}{39}, \frac{41}{59}, \text{ and } \frac{27}{78}$$

$$(58) \frac{71}{81}, \frac{39}{261}, \frac{410}{701}, \text{ and } \frac{7}{81}$$

$$(59) \frac{813}{401}, \frac{710}{3026}, \frac{762}{980}, \text{ and } \frac{83}{72}$$

To reduce fractions from one denomination to another.

**RULE.**

If from a lower term to a higher, multiply the denominator as in reduction of whole numbers. If from a higher term to a lower, multiply the numerator as in reduction of whole numbers.

Reduce  $\frac{2}{3}$  of a farthing to the fraction of a pound.

Here the denominator is multiplied,  $\frac{2}{3 \times 4 \times 12 \times 20} = \frac{2}{2880}$   
as it is brought to a higher term.

Reduce  $\frac{3}{5}$  of a pound to the fraction of a penny.

Here the numerator is multiplied, as it  $\frac{3 \times 20 \times 12}{5} = \frac{720}{5}$   
is to be brought to a lower name.

1. Reduce  $\frac{3}{7}$  of a farthing to the fraction of a pound.
2. "  $\frac{7}{8}$  of a pound to the fraction of a penny.
3. "  $\frac{4}{5}$  of a shilling to the fraction of a guinea.
4. "  $\frac{4}{5}$  of a shilling to the fraction of a farthing.
5. "  $\frac{7}{8}$  of a farthing to the fraction of a crown.
6. "  $\frac{3}{10}$  of a day to the fraction of a week.
7. "  $\frac{7}{9}$  of a week to the fraction of an hour.
8. "  $\frac{3}{5}$  of a nail to the fraction of a yard.
9. "  $\frac{7}{8}$  of a cwt. to the fraction of a dram.
10. "  $\frac{4}{5}$  of a yard to the fraction of a mile.

To express any given quantity as a fraction of another quantity, considered as an integer.

**RULE.**

Reduce both quantities to one denomination; then make the reduced integer the denominator, and the other quantity the numerator.

What part of 1*l.* is 13*s.* 4*d.*?

Here both quantities, the 1*l.* and the 13*s.* 4*d.*, are reduced to pence; the pence in the integer, 240, is made the denominator, and the pence in the other quantity is made the numerator; the fraction,  $\frac{160}{240}$  of a pound, is, when brought to its lowest terms, equal to  $\frac{2}{3}$  of a pound.

£	s.	d.
1	13	4
20	12	
—	—	
20	160	
12	—	
—	—	
240		
then $\frac{160}{240} = \frac{2}{3}$ Ansr.		

11. Reduce 14*s.* 6*d.* to the fraction of a pound.
12. " 17*s.* 4*d.* to the fraction of a pound.
13. " 5*s.* 8 $\frac{1}{4}$ *d.* to the fraction of a pound.

14. Reduce 17s. 9d. to the fraction of a penny.
15. „ 6s. 7 $\frac{3}{4}$ d. to the fraction of a farthing.
16. „ 7 hours 21 minutes to the fraction of a day.
17. „ 7 lbs. 3 drams to the fraction of a cwt.
18. „ 8 cwt. 2 qrs. 14 lbs. to the fraction of an ounce.
19. „ 3 lbs. 9 ozs. to the fraction of a dwt.
20. „ 16 hours 13 minutes to the fraction of a day.

To find the value of a fraction.

#### RULE.

Reduce the numerator to the next inferior term and divide by the denominator; reduce the remainder, if any, to the next lower term, and divide again; and so on to the lowest term.

What is the value of  $\frac{7}{8}$  of a pound sterling?

Here the numerator, 7, is multiplied by 20, to bring it to the next inferior term, 140s.; the 140s. are to be divided by 8, which gives 17, and 4 remainder; the 4 is multiplied by 12, to bring it to the next inferior term, 48 pence; it is then divided by 8, which gives 6 without any remainder. The answer then is 17s. 6d. which is the  $\frac{7}{8}$  of a pound.

$$\begin{array}{r}
 7 \\
 20 \overline{) 140} \\
 \underline{140} \\
 0
 \end{array}$$
  

$$\begin{array}{r}
 17-4 \\
 12 \overline{) 48} \\
 \underline{48} \\
 0
 \end{array}$$

21. What is the value of  $\frac{6}{7}$  of a pound?
22. What is the value of  $\frac{5}{6}$  of a shilling?
23. What is the value of  $\frac{4}{5}$  of a crown?
24. What is the value of  $\frac{9}{11}$  of a day?
25. What is the value of  $\frac{1}{2}\frac{1}{3}$  of a guinea?
26. What is the value of  $\frac{4}{5}$  of a yard long measure?
27. What is the value of  $\frac{1}{16}$  of a lb. troy?
28. What is the value of  $\frac{1}{16}$  of a lb. avoirdupoise?
29. What is the value of  $\frac{3}{4}$  of a cwt.?
30. What is the value of  $\frac{1}{4}$  of a mile?

#### ADDITION.

##### RULE.

Reduce compound fractions to simple fractions, and mixed numbers to improper fractions. Having done this, bring them

to a common denominator. Add all the numerators together, and place, under the result, the common denominator. If the answer be an improper fraction bring it to a mixed number.

Add together the following fractions  $\frac{2}{3}$ ,  $\frac{1}{2}$ , and  $4\frac{1}{2}$ .

Here the mixed number  $4\frac{1}{2}$  is first brought to the improper fraction  $\frac{9}{2}$ , and then all the fractions are brought to a common denominator.

$2 \times 5 \times 2 = 20$	}	numerators.
$3 \times 3 \times 2 = 18$		
$9 \times 3 \times 5 = 135$		
<hr/>		
$3 \times 5 \times 2 = 30$		com. denom.

$$\text{Therefore } \frac{20}{30} + \frac{18}{30} + \frac{135}{30} = \frac{173}{30} = 5\frac{23}{30} \text{ sum required.}$$

Add together the following fractions and mixed numbers.

$$(1) \frac{2}{3} + \frac{3}{5} + \frac{4}{9}$$

$$(2) \frac{3}{7} + \frac{9}{11} + \frac{12}{18}$$

$$(3) \frac{4}{7} + \frac{11}{16} + \frac{18}{23}$$

$$(4) \frac{7}{9} + \frac{13}{17} + \frac{14}{19} + \frac{23}{121}$$

$$(5) \frac{8}{13} + \frac{11}{23} + \frac{9}{17} + \frac{14}{39}$$

$$(6) \frac{21}{42} + \frac{41}{53} + \frac{71}{89} + \frac{22}{23}$$

$$(7) \frac{2}{5} \text{ of } \frac{6}{7} + \frac{2}{13} + \frac{2}{3} \text{ of } \frac{7}{8}$$

$$(8) \frac{4}{7} + \frac{9}{13} \text{ of } \frac{12}{19} + \frac{4}{9} \text{ of } 5\frac{1}{2}$$

$$(9) 92\frac{5}{14} + 37\frac{8}{19} + 7\frac{4}{6}$$

$$(10) \frac{21}{23} + \frac{11}{15} \text{ of } 2\frac{3}{4} + \frac{2}{9} \text{ of } 6\frac{2}{3}$$

$$(11) \frac{17}{19} \text{ of } \frac{23}{49} \text{ of } 17\frac{4}{9} + \frac{4}{7} \text{ of } 12$$

$$(12) \frac{13}{27} + \frac{19}{23} \text{ of } 9\frac{2}{3} + \frac{11}{35} \text{ of } 8\frac{4}{7}$$

## SUBTRACTION.

### RULE.

Reduce the fractions to common denominators, as in Addition. Find the difference of the numerators, under which write the common denominator.

From  $\frac{1}{3}$  take  $\frac{1}{4}$ .

Here the fractions are first brought to a common denominator; then the 60 taken from 84, and the common denominator written under the difference.

$$\begin{array}{l} 12 \times 7 = 84 \\ 4 \times 15 = 60 \\ 15 \times 7 = 105 \end{array} \left. \begin{array}{l} \text{numerators.} \\ \\ \text{com. denom.} \end{array} \right\}$$

Therefore  $\frac{84}{105} - \frac{60}{105} = \frac{24}{105}$  the answer.

What is the difference between the following fractions?

(1)  $\frac{4}{7} - \frac{3}{4}$

(2)  $\frac{6}{11} - \frac{8}{9}$

(3)  $\frac{7}{15} - \frac{4}{18}$

(4)  $\frac{9}{18} - \frac{6}{19}$

(5)  $4\frac{1}{2} - \frac{9}{16}$

(6)  $\frac{27}{8} - 5\frac{4}{7}$

(7)  $2\frac{1}{2} - 3\frac{3}{8}$

(8)  $6\frac{7}{8} - 9\frac{1}{10}$

(9)  $\frac{9}{11} - \frac{1}{18}$  of 4.

(10)  $\frac{11}{54} - \frac{3}{28}$  of  $\frac{5}{6}$

(11)  $169 - 14\frac{7}{8}$

(12)  $76\frac{1}{2} - \frac{2}{3}$  of 19.

## MULTIPLICATION.

### RULE.

Reduce the mixed numbers to improper fractions, and compound fractions to simple ones; after this has been done, multiply all the numerators together for the numerator of the product, and all the denominators together for its denominator.

Multiply  $6\frac{2}{3}$  by  $\frac{2}{3}$  of  $\frac{7}{8}$ .

Here the mixed number  $6\frac{2}{3}$  is  $6\frac{2}{3} = \frac{20}{3}$  and  $\frac{2}{3}$  of  $\frac{7}{8} = \frac{14}{24}$ .  
 Converted into the improper fraction  $\frac{20}{3} \times \frac{14}{24} = \frac{280}{24} = 11\frac{14}{24}$  Ansr.  
 Then  $\frac{20}{3}$  and the compound fraction  $\frac{2}{3}$  of  $\frac{7}{8}$  into the simple fraction  $\frac{14}{24}$ . The numerators and denominators being multiplied, produce the improper fraction  $\frac{280}{24}$ , which being reduced to a mixed number gives  $11\frac{14}{24}$  the answer.

Multiply together the following fractions:—



- (1)  $\frac{3}{4} \times \frac{5}{8}$       (2)  $\frac{7}{9} \times \frac{8}{11}$       (3)  $\frac{9}{11} \times \frac{11}{12}$   
 (4)  $\frac{4}{18} \times \frac{4}{27}$       (5)  $8\frac{3}{4} \times \frac{5}{12}$       (6)  $7 \times \frac{5}{10}$   
 (7)  $5\frac{3}{4} \times 11\frac{1}{4}$       (8)  $3\frac{3}{8} \times 4\frac{5}{8}$       (9)  $8\frac{2}{3} \times \frac{2}{3} \text{ of } \frac{7}{8}$   
 (10)  $16 \times \frac{4}{7} \text{ of } \frac{8}{13}$       (11)  $17\frac{2}{3} \times \frac{17}{19} \text{ of } 7\frac{1}{2}$   
 (12)  $24\frac{7}{13} \times \frac{13}{16} \text{ of } 9\frac{1}{2}$

## DIVISION.

## RULE.

Prepare the fractions as in Multiplication, then invert divisor and proceed as in Multiplication.

Divide  $\frac{4}{7}$  by  $\frac{3}{5}$ .  $\frac{4}{7} \div \frac{3}{5}$  inverted thus:  $\frac{4 \times 5}{7 \times 3} = \frac{20}{21}$ .

- |   |   |
|---|---|
| (1) Divide $\frac{14}{15}$ by $\frac{11}{12}$ | (7) Divide $5\frac{5}{7}$ by $\frac{5}{7}$                              |
| (2) " $\frac{21}{80}$ " $\frac{3}{10}$        | (8) " $3\frac{1}{4}$ " $\frac{5}{12}$                                   |
| (3) " $\frac{15}{16}$ " $\frac{4}{5}$         | (9) " $8\frac{1}{2}$ " $9\frac{1}{2}$                                   |
| (4) " $\frac{33}{35}$ " $\frac{3}{8}$         | (10) " $9\frac{1}{2}$ " $\frac{1}{2} \text{ of}$                        |
| (5) " $\frac{12}{87}$ " $\frac{18}{48}$       | (11) " $116\frac{4}{13}$ " $\frac{1}{2} \text{ of}$                     |
| (6) " $\frac{16}{351}$ " $\frac{4}{27}$       | (12) " $\frac{2}{3} \text{ of } \frac{3}{4}$ " $\frac{1}{2} \text{ of}$ |

## PROPORTION OF FRACTIONS.

## RULE.

Proceed as in simple proportion, that is—  
 Let the third term be like the answer.

Let the first and second be of the same name.

If fractions, or mixed numbers, are found in one or more of the terms—reduce them if they are complex fractions, compound fractions, or mixed numbers, to improper fractions.

#### EXAMPLE.

If 12 men build  $3\frac{5}{7}$  yards of a wall in  $\frac{3}{4}$  of a week, how long will they require to build 47 yards?

$$3\frac{5}{7} \text{ yards} = \frac{26}{7} \text{ yards: therefore}$$

$$\frac{26}{7} : 47 :: \frac{3}{4} : \frac{\frac{3}{4} \times 47}{\frac{26}{7}} = 9\frac{1}{2} \text{ weeks nearly.}$$

If all the terms are fractions.

#### RULE.

Invert the first, and then multiply all the terms together.

#### EXAMPLE.

If  $\frac{3}{4}$  of a regiment consume  $1\frac{1}{2}$  of 40 tons of flour in  $\frac{4}{5}$  of a year, how long will  $\frac{5}{6}$  of the same regiment take to consume it?

$$\frac{5}{6} : \frac{3}{4} :: \frac{4}{5} : \frac{3}{4} \times \frac{4}{5} \div \frac{5}{6} = \frac{3}{4} \times \frac{4}{5} \times \frac{6}{5} = \frac{72}{100} = 262.8 \text{ days.}$$

If the first and second, or the first and third terms are fractions.

#### RULE.

Reduce them to a common denominator (should they not have one already), and then omit the denominators.

#### EXAMPLE.

If  $\frac{2}{3}$  of 1 cwt. of rice cost 2*l*., what will  $\frac{9}{10}$  of a cwt. cost?

$$\frac{2}{3} : \frac{9}{10} :: 2 : ?$$

Reducing the fractions to a common denominator, we have

$$\frac{20}{30} : \frac{27}{30} :: 2 : 1$$

and omitting the denominator,

$$20 : 27 :: 2 : \frac{27 \times 2}{20} = 2l. 14s.$$

N.B.—This is merely multiplying the first and second, or the first and third terms by the common denominator—which does not alter the proportion.

1. What will  $\frac{3}{4}$  of a yard cost, if 1 yard costs 13s. 6d.?
2. If 1 lb. of spice cost  $\frac{3}{4}s.$ , what will 1 lb. 14 oz. cost?
3. If 1 oz. of silver cost  $5\frac{3}{8}s.$ , what will  $\frac{3}{4}$  oz. cost?
4. How much will  $\frac{1}{2}$  yard come to if  $\frac{7}{8}$  cost  $\frac{5}{8}s.$ ?
5. If  $2\frac{1}{2}$  yards of flannel cost  $3\frac{1}{3}s.$ , what is the price of  $4\frac{3}{4}$  yards?
6. If  $\frac{3}{16}$  of a ship costs cost 273 $\frac{1}{8}l.$ , what is  $\frac{5}{32}$  of her worth?
7. What is the price of 49 $\frac{3}{11}$  yards of cloth, if  $7\frac{5}{8}$  cost 7l. 18s. 4d.?
8. If 100l. of stock is worth 98 $\frac{7}{8}l.$ , what will 362l. 8s. 7 $\frac{1}{2}d.$  be worth?
9. If 9 $\frac{1}{4}s.$  is paid for  $4\frac{5}{8}$  yards, how much can be bought for 2 $\frac{3}{11}l.$ ?

#### QUESTIONS FOR THE PUPIL.

What is a fraction, and how is it represented?

Define and explain the following terms—Numerator, Denominator, Proper fraction, Improper fraction, Compound fraction, Mixed number.

How may any whole number be made a fraction of?

When is the value of a fraction not altered by multiplying or dividing both the numerator and denominator?

How is an improper fraction changed into a whole or mixed number?

How do you reduce a mixed number to an improper fraction?

How is a compound fraction reduced to a simple one?

How is a fraction reduced to its lowest terms?

How do you reduce fractions to a common denominator?

Define and explain the terms common measure, greatest

common measure, multiple, common multiple, least common multiple; and how are these operations performed?

How do you reduce fractions from one denomination to another?

How do you express any given quantity as a fraction of another quantity, considered as an integer?

How is the value of a fraction found?

How is a question in the Rule of Proportion solved if fractions or mixed numbers are found in one or more of the terms? If all the terms are fractions? If the first and second, or the first and third terms, are fractions?

## DECIMAL FRACTIONS.

A Decimal Fraction is a fraction whose denominator is 10, 100, 1000, &c., or a unit with as many ciphers annexed to it as there are figures in the numerator. Thus  $\frac{5}{10}$ ,  $\frac{25}{100}$ ,  $\frac{325}{1000}$ , are decimal fractions, and are usually written thus:  $\cdot 5$ ,  $\cdot 25$ ,  $\cdot 325$ , the numerators being omitted; but a point is placed on the left hand to distinguish them from integers. In reading them the first is called 5-tenths, the second 25-hundredths, and the third 325-thousandths.

When there are not so many figures in the numerator as there are ciphers in the denominator, as many ciphers as are necessary must be prefixed: thus  $\frac{3}{100} = \cdot 03$  and  $\frac{3}{1000} = \cdot 003$ .

Ciphers on the left hand of a decimal *decrease* its value tenfold: thus,  $\cdot 5$  is 5-tenths,  $\cdot 05$  is 5-hundredths, and  $\cdot 005$  is 5-thousandths. Ciphers on the right do not alter the value, for  $\cdot 5$ ,  $\cdot 50$ ,  $\cdot 500$ , are the same as  $\frac{5}{10}$ ,  $\frac{50}{100}$ ,  $\frac{500}{1000}$ , and these are of equal value.

## ADDITION.

### RULE.

Place the numbers to be added so that the decimal points be directly under each other, and add as in Simple Addition. Insert the point in the answer directly under the other points.

Add together the following numbers:—

(1)	(2)	(3)	(4)	(5)
2.13	43.27	820.71	4.231	723.312
.426	9.042	2.006	72.32	91.000
21.2	712.417	84.243	920.74	2.025
7.63	41.007	217.072	.9874	3724.7
640.072	.962	9.341	376.05	.000

$$(6) \quad 37.214 + .736 + 7213.04 + 123.476 + 21.6743.$$

$$(7) \quad 800.273 + 498.0009 + .296 + .0071 + 4260.008.$$

$$(8) \quad 320.492 + .23687 + 970.0083 + 9.086 + 41.762.$$

## SUBTRACTION.

### RULE.

Place the numbers as in Addition, subtract as in Six Numbers, and insert the point under the other points.

(1)	From	72.378	take	4.861
(2)	"	.9.007	"	.962
(3)	"	41.217	"	7.0968
(4)	"	298.012	"	.9999
(5)	"	840.001	"	170.98
(6)	"	279.712	"	97.0076
(7)	"	72.0076	"	1.973
(8)	"	.900.005	"	89.1171
(9)	"	243.21	"	.964213
(10)	"	462.0068	"	134.791.

## MULTIPLICATION.

### RULE.

Arrange the factors, and multiply as in Whole Numl Reckon the number of decimals in both factors, and poin as many from the right of the product. When the numbe figures in the product is not so many as the number of ( mals in both factors, as many ciphers as may be necessa make up the deficiency must be placed at the left of product.

### EXAMPLES.

1. Multiply 7.4 by .35.

$$\begin{array}{r}
 7.4 \\
 .35 \\
 \hline
 370 \\
 222 \\
 \hline
 2.590
 \end{array}$$

In this example there are 3 decimal places in the multiplicand and multiplier, therefore 3 figures are pointed off from the right of the product.

2. Multiply  $\cdot 045$  by  $\cdot 03$ .

$$\begin{array}{r} \cdot 045 \\ \cdot 03 \\ \hline \cdot 00135 \end{array}$$

Here there are 5 decimal places in the factors, and only 3 figures in the product; therefore 2 ciphers are placed at the left of the product to make the number of decimal places in the product equal to those in the factors.

In order to multiply a decimal by 10, remove the point one figure to the right; if by 100, remove it two places, and so on.

- |  |                                       |                                      |
|--|---------------------------------------|--------------------------------------|
| (1) $\cdot 27 \times \cdot 27$ .       | (2) $4\cdot 21 \times 3\cdot 41$ .    | (3) $97\cdot 04 \times 80\cdot 03$ . |
| (4) $\cdot 4102 \times \cdot 1004$ .   | (5) $\cdot 700 \times \cdot 806$ .    | (6) $\cdot 879 \times 10$ .          |
| (7) $2300\cdot 7 \times 48\cdot 003$ . | (8) $704\cdot 23 \times \cdot 0007$ . | (9) $\cdot 786 \times 100$ .         |
| (10) $4\cdot 862 \times \cdot 75$ .    | (11) $200\cdot 03 \times \cdot 002$ . | (12) $\cdot 00076 \times 1000$ .     |

*Proof.*—When the multiplier does not exceed 12: Multiply the multiplicand by the multiplier minus one, and add the multiplicand to the product.

When the multiplier exceeds 12: Multiply the multiplier by the multiplicand. Or, if preferred, the proof may be obtained by Division, which is reversing the process.

## DIVISION.

### RULE.

Divide as in Whole Numbers. Point off as many decimal places in the quotient, as the dividend has more than the divisor; if necessary place ciphers to the left of the quotient.

If the divisor has more figures than the dividend, add ciphers to the right of the dividend.

When there is a remainder, the quotient may be carried to any degree of exactness by annexing ciphers to the remainder.

### EXAMPLES.

1. Divide  $4\cdot 7614$  by  $3\cdot 8$ .

$$3\cdot 8 \overline{) 4\cdot 7614} \quad (1\cdot 253$$

Here the decimals in the dividend exceed those in the divisor by 3; three figures are therefore marked off in the quotient.

2. Divide  $\cdot 7644$  by 42.

$$42 \overline{) 7644} \quad (.0182$$

In this example the decimals in the dividend exceed those in the divisor by 4; a cipher is therefore prefixed in the quotient to make four decimal places.

To divide by 10, 100, &c., remove the decimal place of the dividend as many places to the left as there are ciphers.

- |                                 |                                  |                              |
|---------------------------------|----------------------------------|------------------------------|
| (1) $6\cdot74 \div 2\cdot34.$   | (2) $\cdot496 \div \cdot278.$    | (3) $7\cdot6 \div \cdot734.$ |
| (4) $7\cdot23 \div 4\cdot06.$   | (5) $\cdot024 \div \cdot001.$    | (6) $29\cdot6 \div 10.$      |
| (7) $724\cdot1 \div 38\cdot07.$ | (8) $82\cdot03 \div 9\cdot0002.$ |                              |
| (9) $7\cdot624 \div 2\cdot001.$ | (10) $\cdot5213 \div 24121.$     |                              |
| (11) $31 \div \cdot124689.$     | (12) $3463\cdot9 \div 1000.$     |                              |

Proof may be obtained by Multiplication as in Simple Division.

### REDUCTION OF DECIMALS.

To reduce a vulgar fraction to a decimal.

#### RULE.

Divide the numerator by the denominator; annexing as many ciphers to the numerator as may be necessary. Point off as many decimal places in the quotient as there were ciphers annexed to the numerator.

#### EXAMPLES.

1. Reduce  $\frac{1}{2}$  to a decimal.

$$\begin{array}{r} 2 \overline{) 10} \\ \hline \cdot5 \text{ answer.} \end{array}$$

2. Reduce  $\frac{3}{4}$  to a decimal.

$$\begin{array}{r} 4 \overline{) 300} \\ \hline \cdot75 \text{ answer.} \end{array}$$

Reduce the following fractions to decimals.

- (1)  $\frac{5}{8}$ .      (2)  $\frac{1}{4}$ .      (3)  $\frac{7}{8}$ .      (4)  $\frac{1}{3}$ .      (5)  $\frac{5}{6}$ .  
 (6)  $\frac{1}{6}$ .      (7)  $\frac{9}{16}$ .      (8)  $\frac{1}{75}$ .      (9)  $\frac{16}{17}$ .      (10)  $\frac{8}{11}$   
 (11)  $\frac{275}{3842}$ .      (12)  $\frac{1}{1876}$ .

To reduce a decimal to a vulgar fraction.

#### RULE.

Make the given decimal the numerator, and place under it, for a denominator, a unit with as many ciphers as there are places in the decimal.

#### EXAMPLES.

1. Reduce  $\cdot 5$  to a vulgar fraction. Ansr.  $\frac{5}{10}$ .  
 2. Reduce  $\cdot 078$  to a vulgar fraction. Ansr.  $\frac{78}{1000}$ .  
 Reduce the following decimals to vulgar fractions.

- (13)  $\cdot 25$ .      (14)  $\cdot 625$ .      (15)  $\cdot 375$ .      (16)  $\cdot 005$ .  
 (17)  $\cdot 01$ .      (18)  $\cdot 001$ .      (19)  $\cdot 41$ .      (20)  $\cdot 021$ .  
 (21)  $\cdot 007$ .      (22)  $\cdot 019$ .

To reduce numbers of a lower denomination to the decimal of a higher.

#### RULE.

Write the given numbers, if more than one, directly under each other, beginning with the lowest, and divide by as many of the lower as make one of the higher, annexing ciphers if necessary.

#### EXAMPLES.

1. Reduce 12s. 3d. to the decimal of a pound.

$$\begin{array}{r} 12 \ ) \ 3 \cdot 00 \\ \hline 20 \ ) \ 12 \cdot 250 \\ \hline \cdot 6125 \text{ Answer.} \end{array}$$

Here the shillings and pence are placed under each other, beginning with the lower; and each divided by as many of the lower as make one of the higher.



2. Reduce 16s. 6½*d.* to the decimal of a pound.

$$\begin{array}{r}
 4 \ ) \ 3 \cdot 00 \\
 \hline
 12 \ ) \ 6 \cdot 7500 \\
 \hline
 20 \ ) \ 16 \cdot 5625 \\
 \hline
 \underline{.828125} \text{ Answer.}
 \end{array}$$

In this example the farthings, pence, and shillings are placed under each other, beginning with the lowest; each is then divided by as many of the lower as make one of the higher.

Proof by contrary process—

$$\begin{array}{r}
 .828125 \\
 20 \\
 \hline
 16 \cdot 56250 \\
 12 \\
 \hline
 6 \cdot 75000 \\
 4 \\
 \hline
 3 \cdot 00000 \qquad 16s. \ 6\frac{1}{2}d.
 \end{array}$$

23. Reduce 19s. 5½*d.* to the decimal of a pound.

24. „ 15s. 9¾*d.* to the decimal of a pound.

25. „ 13s. 4*d.* to the decimal of a pound.

26. „ 9*d.* to the decimal of a pound.

27. „ 3 cwt. 2 qrs. 8 lbs. to the decimal of a cwt.

28. „ 4 feet 3 inches to the decimal of a yard.

29. „ 26 min. 34 sec. to the decimal of a week.

30. „ 5 furlongs 3 poles to the decimal of a mile.

31. „ 4¾*d.* to the decimal of a guinea.

32. „ 5 dwts. 12 grs. to the decimal of an ounce.

33. „ 2 roods 12 perches to the decimal of an acre.

34. „ 17 yards 1 ft. 6 in. to the decimal of a mile.

To find the value of a decimal.

#### RULE.

Multiply the decimal by as many of the next lower denomination as make one of the given denomination. Point from the product as many decimal places as are in the given decimal.

decimal. Proceed thus to the lowest denomination, the figures on the left of the points are the value of the decimal.

What is the value of  $\cdot 427$  of a pound.

$$\begin{array}{r}
 \cdot 427 \\
 20 \\
 \hline
 8 \cdot 540 \\
 12 \\
 \hline
 6 \cdot 480 \\
 4 \\
 \hline
 1 \cdot 920 \\
 \hline
 \end{array}$$

Answer, 8s.  $6\frac{1}{2}$ d.

What is the value of  $\cdot 243$  of a day.

$$\begin{array}{r}
 \cdot 243 \\
 24 \\
 \hline
 5 \cdot 832 \\
 60 \\
 \hline
 49 \cdot 920 \\
 60 \\
 \hline
 55 \cdot 200 \\
 \hline
 \end{array}$$

Answer, 5hrs. 49min. 55. sec.

- |     |                       |  |
|-----|-----------------------|--|
| 35. | {                     | $\cdot 7634$ l.?                           |
| 36. |                       | $\cdot 3412$ l.?                           |
| 37. |                       | $\cdot 0076$ l.?                           |
| 38. |                       | $\cdot 764$ cwt.?                          |
| 39. |                       | $\cdot 936$ lb. avoirdupois?               |
| 40. |                       | $\cdot 007$ ton?                           |
| 41. |                       | What is the value of $\cdot 732$ shilling? |
| 42. |                       | $\cdot 079$ crown?                         |
| 43. |                       | $\cdot 9218$ day.                          |
| 44. |                       | $\cdot 496$ yard?                          |
| 45. | $\cdot 0796$ mile?    |  |
| 46. | $\cdot 732$ lb. troy? |  |

The following will be found useful, and, being intimately connected with the doctrine of fractions, may be introduced here with advantage.

To find at once what decimal of a pound is equivalent to any number of shillings, pence, &c.

When there is an even number of shillings.

#### RULE.

Consider them to be half as many tenths of a pound

#### EXAMPLE.

$16s. = 0 \cdot 8$ l.—every  $2s.$  are equal to  $\frac{1}{10}$  of a £.: therefore  
 $8 \times 2 = \frac{8}{10}$ .

When the number of shillings is odd :

Consider half the next lower even number as so many tenths of a pound, and with these set down 5 hundredths.

#### EXAMPLES.

$15s. = 0.75\text{£}$ . For  $15s. = 14s. + 1s.$ : but by the last rule  $14s. = 0.7\text{£}$ : and since  $2s. = \frac{1}{10}$ , or, as it is evident, 10 hundredths of a pound,  $1s. = .05$ .

To find at once the number of shillings, pence, &c., in any decimal of a £.

#### RULE.

Double the number of tenths for shillings,—to which, if the hundredths are not less than 5, add one. Consider the digit in the second place (after subtracting 5, if it is not less than 5) as tens, and that in the third as units of farthings; and subtract unity from the result if it exceeds 24.

#### EXAMPLE.

$0.6874\text{£} = 13s. 9d.$  6-tenths are equal to 12s. as the hundredths are not less than 5, there is an additional shilling, which makes 13s.; subtracting 5 from the hundredths and adding the remainder (reduced to thousandths) to the thousandths, we have 37 thousandths from which—since they exceed 24 we subtract unity: this leaves 36 as the number of farthings.  $0.6874\text{£}$ . therefore is equal to 13 shillings and 36 farthings, or  $13s. 9d.$

### CIRCULATING DECIMALS.

We cannot always obtain an exact quotient when we divide one number by another: in such a case, what is called an interminate or (because the same digit or digits constantly recur or circulate) a recurring or circulating decimal is produced. The decimal is said to be terminate if there is an exact quotient, or one which leaves no remainder.

An interminate decimal, in which only a single digit is repeated, is called a repetend; if two or more digits constantly recur, they form a periodical decimal. Thus  $.77, \&c.$  is a repetend; but  $.597597, \&c.$  is a periodical. For the sake of brevity, the repeated digit or period is set down but

re, and may be marked as follows,  $\cdot 5'$  ( $= \cdot 555$ , &c.) or  $\cdot 93'$  ( $= 493493493$ , &c.)

When the decimal contains only an infinite part—that is, only the repeated digit, or period—it is a pure repetend or a pure periodical. But when there is both a finite and an infinite part, it is a mixed repetend or mixed circulate. Thus— $\cdot 3'$  ( $= \cdot 333$ , &c.) is a pure repetend.

$\cdot 578'$  ( $= \cdot 57888$ , &c.) is a mixed repetend.

$\cdot 397'$  ( $= \cdot 397397397$ , &c.) is a pure circulate.

$\cdot 865'64271'$  ( $= \cdot 865642716427164271$ , &c.) is a mixed circulate.

### RULE.

If the decimal is a *pure repetend*, put the repeated digit for numerator, and 9 for denominator.

If it is a *pure periodical*, put the period for numerator, and as many nines as there are digits in the period for denominator.

### EXAMPLES.

1. What vulgar fraction is equivalent to  $\cdot 3'$ ? Ans.  $\frac{3}{9}$ .

2. What vulgar fraction is equivalent to  $\cdot 7854'$ ? Ans.  $\frac{7854}{9999}$ .

If the decimal is a mixed repetend, or a mixed circulate.

### RULE.

Subtract the finite part from the whole, and set down the difference for numerator; put for denominator so many ciphers there are digits in the finite part, and to the left of the ciphers so many nines as there are digits in the infinite part.

### EXAMPLE.

What is the vulgar fraction equivalent to  $\cdot 97'8734'$ ?

There are 2 digits in 97, the finite part, and 4 in 8734, the infinite part. Therefore,

$$\frac{97 \cdot 8734 - 97}{999900} = \frac{978637}{999900} \text{ is the required vulgar fraction.}$$

### EXERCISES.

- |   |                     |     |              |     |                     |     |                |                     |
|---|---------------------|-----|--------------|-----|---------------------|-----|----------------|---------------------|
| } | $0 \cdot 5'$        | (2) | $0 \cdot 8'$ | (3) | $0 \cdot 73'$       | (4) | $0 \cdot 145'$ |                     |
|   | $0 \cdot 83'25'$    |     | (6)          |     | $0 \cdot 147'0658'$ |     | (7)            | $0 \cdot 432'0075'$ |
|   | $301 \cdot 82'758'$ |     |              |     |                     |     |                |                     |

Contractions in Multiplication and Division (derived from the properties of fractions).

To multiply any number by 5.—Remove it one place to the left hand, and divide the result by 2.

$$\text{Example.}—736 \times 5 = \frac{7360}{2} = 3680.$$

To multiply by 25.—Remove the quantity two places to the left, and divide by 4.

$$\text{Example.}—6732 \times 25 = \frac{673200}{4} = 168300.$$

To multiply by 125.—Remove the quantity three places to the left, and divide the result by 8.

$$\text{Example.}—7865 \times 125 = \frac{7865000}{8} = 983125.$$

To multiply by 75.—Remove the quantity two places to the left, then multiply the result by 3, and divide the product by 4.

$$\text{Example.}—685 \times 75 = \frac{68500 \times 3}{4} = \frac{205500}{4} = 51375.$$

To multiply by 35.—To the multiplicand removed two places to the left and divided by 4, add the multiplicand removed one place to the left.

$$\text{Example.}—67896 \times 35 = \frac{6789600}{4} + 67896 = 1697400 + 67896 = 2376360.$$

To divide by any one of the before-named multipliers.—

$$\text{Example.}—\text{Divide } 847 \text{ by } 5. \quad 847 \div 5 = 847 \div \frac{10}{2} = 847 \times \frac{2}{10} = 169\frac{4}{10}.$$

Sometimes what is convenient as a multiplier will not be equally so as a divisor: thus 35. For it is not so easy to divide, as to multiply by  $10\frac{1}{4} + 10$ , its equivalent multiplier number.

#### QUESTIONS FOR THE PUPIL.

What are decimal fractions and how are they expressed?  
How is a decimal changed into a decimal fraction?

Are the methods of adding, &c., vulgar and decimal fractions different?

How is a vulgar reduced to a decimal fraction?

How is a decimal of a lower reduced to one of a higher denomination?

How is the value of a decimal found?

How are pounds, shillings, and pence changed at once into the corresponding decimal of a pound?

How is the decimal of a pound changed at once into shillings, pence, &c.?

What are terminate and circulating decimals?

What are a repetend and a periodical, a pure and a mixed circulate?

How is a pure circulate or pure repetend changed into an equivalent vulgar fraction?

How is a mixed repetend or a mixed circulate reduced to an equivalent vulgar fraction?

How can the properties of fractions be used as a means of abbreviating the process of Multiplication and Division?

## DUODECIMALS OR CROSS MULTIPLICATION.

Duodecimal or Cross Multiplication is made use of by artificers in measuring their work. The dimensions are taken in feet, inches, and parts. The foot is divided into 12 parts called inches; the inch into 12 parts called seconds; the seconds into 12 parts called thirds; and the thirds into 12 parts called fourths. Three seconds are marked thus, 3''; thirds thus, 3''' ; and fourths thus, 3''''.

### EXAMPLES.

1. Multiply 4 ft. 6 in. by 2 ft. 2 in.

### RULE.

Place the multiplier under the multiplicand, feet under feet, inches under inches, &c. Multiply the multiplicand, beginning at the lowest term (6), by the highest term in the multiplier (3), carrying by twelves; then multiply by the next lower term in the multiplier, viz. inches, taking care, however, to put the product one place towards the right hand.

ft.	in.
4	6
3	2
<hr/>	
9	0
1	1 6
<hr/>	
10	1 6
<hr/>	

2. Multiply 7 ft.  $6\frac{3}{4}$  in. by 2 ft.  $5\frac{1}{4}$  in.

ft.	in.	"		
7	6	9*		
2	5	8*		
<hr/>				
15	1	6		
3	1	9	9	
	1	10	8	3
<hr/>				
18	5	2"	5'''	4'''

### EXERCISES.

- (1) Multiply 7 feet 9 inches by 5 feet 6 inches  
 (2) " 9 " 5 " 3" by 4 " 8 " 6"  
 (3) " 12 " 8 " 7" by 8 " 4 " 9"  
 (4) " 46 " 11 " 8" by 12 " 0 " 7"  
 (5) " 87 "  $9\frac{1}{4}$  " by 11 "  $10\frac{1}{4}$  "  
 (6) " 687 "  $7\frac{3}{4}$  " by 24 "  $10\frac{1}{4}$  "

To find the superficial content multiply the length by the breadth.

7. Find the content of a board 8 feet 4 inches long and 3 feet 4 inches broad?

8. Find the area of a table 10 feet 9 inches long and 6 feet 4 inches broad?

9. What is the price of a marble slab, the length of which is 6 feet 4 inches, the breadth 3 feet 2 inches, at 7s. per foot?

10. Required the area of a square, the side of it being 23 feet 9 inches?

11. A grave-stone was charged at 5s. 2d. per foot; what was the price of it, the length being 7 feet 2 inches and the breadth 3 feet 6 inches?

12. How much will it cost to pave a yard at 7s. 8d. per foot, the length of it being 26 feet 9 inches and the breadth 12 feet 4 inches?

13. What is the area of a wall, the length of which is 32 feet 7 inches 3'', and the height 9 feet 3 inches 6''?

14. Find the content of a floor 75 feet 9 inches by 17 feet 7 inches?

15. What is the area of a passage floor 75 feet 7 inches in length, and 9 feet 8 inches in breadth?

\* Instead of  $\frac{3}{4}$  inches, 9" are put down, because it is equivalent to  $\frac{3}{4}$  of an inch: in like manner, 3" for a quarter, 6" for the  $\frac{1}{2}$  inch, &c.

What is the content of a floor 39 feet 10 inches 7" in length and 18 feet 8 inches 4" in breadth?

Find the solid content, multiply the length, breadth, and thickness together.

What is the solid content of a block of marble 9 feet 3" long, 5 feet 8 inches broad, and 2 feet 3 inches thick?

Required the solid content of a box  $6\frac{1}{2}$  feet long,  $4\frac{1}{4}$  feet broad, and  $3\frac{1}{4}$  feet deep?

A log of mahogany is 72 feet  $7\frac{1}{2}$  inches long, 5 feet  $6\frac{1}{2}$  inches broad, and 8 feet  $6\frac{1}{2}$  inches thick; required its solid content?

What would be the cost of digging a cellar 18 feet long, 12 feet 9 inches in width, and 9 feet deep, at 6d. per solid yard?

### QUESTIONS FOR THE PUPIL.

What are Duodecimals or Cross Multiplication, and by what is this rule used?

How many parts is a foot divided into?

How many parts is the inch divided and subdivided into?

How are these subdivisions marked or expressed?

How would you express a quarter, half, or three-quarters of an inch?

How is this rule performed?

### EQUATION OF PAYMENTS.

It is a process by which we discover a time, when several debts to be due at *different* periods may be paid *at once*, without loss either to debtor or creditor.

#### RULE.

Multiply each payment by the time which should elapse before it would become due; then, add the products together, and divide their sum by the sum of the debts.

#### EXAMPLES.

A person owes another 20*l.*, payable in 6 months; 50*l.*, payable in 8 months; and 90*l.*, payable in 12 months: at



what time may all be paid together, without loss or gain either party?

$$\begin{array}{rcl}
 \text{£} & & \text{£} \\
 20 \times 6 & = & 120 \\
 50 \times 8 & = & 400 \\
 90 \times 12 & = & 1080 \\
 \hline
 160 & 160 ) & 1600 \text{ (10 the required number} \\
 & & 160 \text{ of months.} \\
 & \hline
 & & \text{---}
 \end{array}$$

2. A debt of 450*l.* is to be paid thus: 100*l.* immediate 300*l.* in 4 months, and the rest in 6 months; when should be paid altogether?

$$\begin{array}{rcl}
 \text{£} & & \\
 100 \times 0 & = & 0 \\
 300 \times 4 & = & 1200 \\
 50 \times 6 & = & 300 \\
 \hline
 450 & 450 ) & 1500 \text{ (3½ months.} \\
 & & 1350 \\
 & \hline
 & & 150 = \frac{1}{2} \\
 & \hline
 & & \text{---}
 \end{array}$$

1. A owes B 600*l.*, of which 200*l.* is payable in 3 months 150*l.* in 4 months, and the rest in 6 months; but it is agreed that the whole sum shall be paid at once; when should payment be made?

2. A debt is to be discharged in the following manner:  $\frac{1}{4}$  present, and  $\frac{1}{4}$  every 3 months after until all is paid; what the equated time?

3. A owes B 110*l.*, of which 50*l.* is to be paid at the end of 2 years, 40*l.* at the end of  $3\frac{1}{2}$ , and 20*l.* at the end of years; when should B receive all at once?

#### QUESTIONS FOR THE PUPIL.

What is meant by the equation of payments?

What is the rule for discovering when money, to be due different times, may be paid at once?

#### EXCHANGE, &c.

Exchange enables us to find what amount of the money one country is equal to a given amount of the money another.

Money is of two kinds, *real*—or coin, and *imaginary*—

ney of exchange, for which there is no coin—as for example, “one pound sterling.”

The *par* of exchange is that amount of the money of one country *actually* equal to a given sum of the money of another; taking into account the value of the metals they contain. The *course* of exchange is that sum which, in point of fact, would be allowed for it.

In exchange, a variable is given for a fixed sum, thus London receives different values for 1*l.* from different countries.

*Agio* is the difference which there is in some places between *rent* or *cash* money, and the *exchange* or *bank-money*—which is finer.

The following tables of foreign coins are to be made familiar to the pupil.

## EXCHANGE TABLES, FOREIGN MONEY.

### MONEY OF AMSTERDAM.

#### FLEMISH MONEY.

8 pennings	make	1 grote or penny.
2 grotes	„	1 stiver
20 stivers	„	1 florin or guilder.
2½ guilders	„	1 rix-dollar.
6 guilders	„	1 pound.

### MONEY OF HAMBURGH.

#### FLEMISH MONEY.

6 pfennings	make	1 grote or penny.
12 grotes	„	1 skilling.
20 skillings	„	1 pound.

#### HAMBURGH MONEY.

12 pfennings, or 2 pence,	make	{ 1 schilling, equal to 1 stiver.
16 schillings	„	1 mark.
2 marks	„	1 dollar of exch.
3 marks	„	1 rix-dollar.

NOTE.—6 schillings = 1 skilling.

Hamburgh money is distinguished by the word “Hambro;”

“Lub.” from Lubec, where it was coined, was formerly used for this purpose :—thus, one “mark Lub.”

We exchange with Holland and Flanders by the pound sterling.

#### FRENCH MONEY.

12 deniers make 1 sou.

20 sous „ 1 livre.

3 livres „ 1 ecu or crown.

Accounts are now kept in francs and centimes.

10 centimes make 1 decime.

10 decimes „ 1 franc.

81 livres = 80 francs.

#### PORTUGUESE MONEY.

Accounts are kept in milrees and rees.

400 rees make 1 crusado.

2½ crusados „ 1 milree.

12 „ „ 1 moidre.

#### SPANISH MONEY.

Spanish money is of two kinds, plate and vellon ; the latter being to the former as 32 is to 17. Plate is used in exchange with us. Accounts are kept in piastres and maravedies.

34 maravedies make 1 real.

8 reals „ 1 piastre or piece of 8.

4 piastres „ 1 pistole of exchange.

375 maravedies „ 1 ducat.

#### AMERICAN MONEY.

In some parts of the United States, accounts are kept in dollars, dimes, and cents.

10 cents make 1 dime.

10 dimes „ 1 dollar.

In other parts accounts are kept in pounds, shillings, pence. These are called currency ; but they are of much less value than with us, paper-money being used.

DANISH MONEY.

12 pfennings make 1 skilling.  
 16 skillings „ 1 mark.  
 6 marks „ 1 rix-dollar.  
 6 Danish = 3-Hamburgh marks.

VENETIAN MONEY.

12 denari (plural of denaro) 1 soldo.  
 20 soldi make 1 lira.  
 6 lire 4 soldi „ 1 ducat current.  
 8 lire „ 1 ducat effective.

AUSTRIAN MONEY.

4 pfennings make 1 creutzer.  
 60 creutzers „ 1 florin.  
 1½ florin „ 1 rix-dollar.

NEAPOLITAN MONEY.

10 grains make 1 carlin.  
 10 carlins „ 1 ducat regno.

GENOESE MONEY.

4 lire and 12 soldi make { 1 scudo di cambio,  
 or crown of exchange.  
 10 lire and 14 soldi „ { 1 scudo d'oro, or gold  
 crown.

MONEY OF GENOA AND LEGHORN.

12 denari di pezza make 1 soldo di pezza.  
 20 soldi di pezza „ 1 pezza of 8 reals.  
 12 denari di lira „ 1 soldo di lira.  
 20 soldi di lira „ 1 lira.  
 1380 denari di lira }  
 215 soldi di lira } „ 1 pezza of 8 reals.  
 or 5¼ lira }

SWEDISH MONEY.

12 fennings, or oers, make 1 skilling.  
 48 skillings „ 1 rix-dollar.

## RUSSIAN MONEY.

100 copecs make 1 rouble.

2 roubles „ 1 ducat.

To reduce bank to current money.

## RULE.

Say, as 100*l.* is to 100*l.* + the agio, so is the given amount of bank to the required amount of current money.

## EXAMPLE.

How many guilders current money are equal to 463 guilders 3 stivers and  $13\frac{6}{7}$  pennings banco, agio being  $4\frac{1}{2}$ ?

100	:	104 $\frac{1}{2}$	::	$\begin{array}{c} g. \\ 463 \end{array}$	$\begin{array}{c} s. \\ 3 \end{array}$	$\begin{array}{c} p. \\ 13\frac{6}{7} \end{array}$	:	:
<u>7</u>		<u>7</u>		<u>20</u>				
700		733		9263	stivers.			
65				16				
<u>45500</u>				<u>148221</u>	pennings.			

$$148221 \times 65 + 64 = 9634429 \times 733 = 7062036457 \div$$

$$45500 = 155209 \text{ pennings} \div 16 \div 20 = 485 \quad 0 \quad 9 \quad \frac{26957}{45500} \text{ sh.}$$

amount sought.

1. Reduce 374 guilders 12 stivers bank money to current money, agio being  $4\frac{1}{2}$  per cent.?

2. Reduce 4378 guilders 8 stivers bank money to current money, agio being  $4\frac{1}{2}$  per cent.?

To reduce current to bank money.

## RULE.

As 100*l.* + the agio is to 100*l.*, so is the given amount of current to the required amount of bank money.

## EXAMPLE.

How much bank money is there in 485 guilders and  $9\frac{5}{7}$  pennings, agio being  $4\frac{1}{2}$ ?

$$\begin{array}{rcl}
 104\frac{1}{2} & : & 100 \\
 7 & & 7 \\
 \hline
 733 & & 700 \\
 45500 & & \hline
 33351500 & & 155209
 \end{array}$$

Multiplying by 45500 the denominator.

$$\begin{array}{rcl}
 & & 7062009500 \\
 \text{And adding} & & 26957 \text{ the numerator.} \\
 \hline
 \end{array}$$

$$\begin{array}{rcl}
 \text{We get} & 70620364\frac{7}{7} & \\
 33351500 ) 4943425519900 & & 700 \\
 \hline
 \text{Quotient} & 148221\frac{1}{3} & 
 \end{array}$$

$148221\frac{1}{3} \div 16 \div 20 = 463g. 3s. 13\frac{1}{3}p.$   
the amount sought.

3. Reduce 58734 guilders 9 stivers 11 pennings current money to bank money,agio being  $4\frac{1}{2}$  per cent.?

4. Reduce 4326 guilders 15 stivers current money to bank money,agio being  $4\frac{1}{7}$  per cent.?

To reduce foreign money to British, &c.

### RULE.

Put the amount of British money considered in the rate of exchange as third term of the proportion, its value in foreign money as first, and the foreign money to be reduced as second term.

#### EXAMPLE 1.—(*Flemish Money.*)

How much British money is equal to 1054 guilders 7 stivers, the exchange being 33s. 4d. Flemish to 1l. British.

$$\begin{array}{rcl}
 s. & d. & \\
 33 & 4 & : \\
 12 & & \\
 \hline
 400 & \text{pence.} & \\
 \hline
 \end{array}
 \quad
 \begin{array}{rcl}
 g. & s. & \\
 1054 & 7 & : : \\
 20 & & \\
 \hline
 21087 & \text{stivers.} & \\
 2 & & \\
 \hline
 400 ) 42174 & \text{Flemish pence.} & \\
 \hline
 \pounds 105.435 & = & \pounds 105 \ 8 \ 8\frac{1}{2}
 \end{array}$$

5. How many pounds sterling in 1680 guilders, at 33s. Flemish per pound sterling?

6. Reduce 6048 guilders to British money, at 33s. 1 Flemish per pound British?

EXAMPLE 2.—(*French Money.*)

Reduce 8654 francs 42 centimes to British money, exchange being 23 francs 50 centimes per one pound British

$$\begin{array}{rcccl} f. & c. & f. & c. & \\ 23 & 50 & : & 8654 & 42 \\ & & :: & 1 & : \end{array} \quad \frac{8654 \cdot 42}{23 \cdot 50} = 368 \quad 5 \quad 5\frac{1}{2}$$

7. Reduce 17969 francs 85 centimes to British money 23 francs 49 centimes per pound sterling?

8. Reduce 7672 francs 50 centimes to British money 23 francs 25 centimes per pound sterling?

From the foregoing examples the pupil will easily perceive how any other kind of foreign may be changed to British money.

To reduce British to foreign money.

RULE.

Put that amount of foreign money which is considered the rate of exchange as the third term, its value in British money as the first, and the British money to be reduced as second term.

EXAMPLE 1.—(*Flemish Money.*)

How many guilders, &c., in 236*l.* 14*s.* 2*d.* British, exchange being 34*s.* 2*d.* Flemish to 1*l.* British?

$$\begin{array}{rcccl} \pounds & s. & d. & & \\ 1 & : & 236 & 14 & 2 \\ \hline & & 20 & & \\ 240d. & & 4734 & & \\ \hline & & 12 & & \\ & & \hline & & 56810d. \end{array} \quad \begin{array}{rcccl} s. & d. & & & \\ 34 & 2 & : & 1 & \\ \hline & 12 & & & \\ & \hline & 410d. \end{array}$$

$$56810 \times 410 \div 240 = 97050 \quad 4 = 404 \quad 7 \quad 6\frac{1}{2} \text{ Flemish; or th}$$

$$\begin{array}{rcl} \pounds 1 & = & \pounds 1 \quad 236 \quad 14 \quad 2 \\ 10s. & = & \frac{1}{2} \quad 118 \quad 7 \quad 1 \\ 2d. & = & \frac{1}{20} \quad 47 \quad 6 \quad 10 \\ & & 120 \left( \frac{1}{20} \text{ of } \frac{1}{2} \right) \quad 1 \quad 19 \quad 5\frac{1}{2} \\ & & \hline & & \pounds 404 \quad 7 \quad 6\frac{1}{2} \end{array}$$

9. In 100*l.* 1*s.* how much Flemish money, exchange at 33*s.* 4*d.* per pound sterling?

10. Reduce 168*l.* 8*s.* 5*d.* British into Flemish, exchange being 33*s.* 3*d.* Flemish per pound sterling?

EXAMPLE 2.—(*French Money*)

How much French money is equal in value to 83*l.* 2*s.* 2*d.*, exchange being 23 francs 25 centimes per *l.* British.

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \quad \text{f.} \\ \text{£1} : 83 \quad 2 \quad 2 :: 23 \cdot 25 : ? \end{array}$$

$$\text{£1} = 240\text{d.} \quad \text{£83 } 2\text{s. } 2\text{d.} = 19946\text{d.} \times 23 \cdot 25 \div 240 = 1932 \cdot 27$$
 or 1932 francs 27 centimes is the required sum.

11. Reduce 274*l.* 5*s.* 9*d.* British to francs, &c., exchange at 23 francs 57 centimes per pound sterling?

12. In 765*l.* how many francs, &c., at 23 francs 49 centimes per pound sterling?

To reduce florins, &c., to pounds, &c., Flemish.

RULE.

Divide the florins by 6 for pounds, and adding the remainder (reduced to stivers) to the stivers, divide the sum by 6 for skillings and double the remainder for grotes.

EXAMPLE.

How many pounds, skillings, and grotes in 165 florins 19 stivers?

$$\begin{array}{r} \text{f.} \quad \text{st.} \\ 6 \overline{) 165 \quad 19} \\ \underline{\phantom{£}27 \quad 13 \quad 2} \end{array}$$

13. In 142 florins 17 stivers, how many pounds, &c.?

14. In 72 florins 14 stivers, how many pounds, &c.?

To reduce pounds, &c., to florins, &c.

RULE.

Multiply the skillings by 6: add to the product half the number of grotes, then for every 20 contained in the sum carry 1, and set down what remains above the twenties as stivers. Multiply the pounds by 6, and adding to the product



what is to be carried from the stivers, consider the sum as florins.

**EXAMPLE.**

How many florins and stivers in 27 pounds 13 skillings and 2 grotes?

£	s.	d.
27	13	2
		6

---

165*l.* 19*s.* the required sum.

---

15. How many florins and stivers in 30 pounds 12 skillings and 1 grote?

16. How many florins, &c., in 129 pounds 7 skillings?

**QUESTIONS FOR THE PUPIL.**

What is Exchange?

What is the difference between real and imaginary money?

What are the par and course of exchange?

What is agio?

What is the difference between current or cash money and exchange or bank money?

How is bank reduced to current money?

How is current reduced to bank money?

How is foreign reduced to British money?

How is British reduced to foreign money?

How are florins, &c., reduced to pounds Flemish, &c.?

How are pounds Flemish, &c., reduced to florins, &c.?

**ARBITRATION OF EXCHANGE, OR CONJOINED PROPORTION.**

In ordinary *Exchange*, only *two places* are concerned; it may sometimes, however, be more beneficial to the merchant to draw *through* one or more other places. The mode of estimating the value of the money of any place not drawn directly, but through one or more other places, is called the *Arbitration of Exchanges*, and is either simple or compound. It is "simple" when there is only *one* intermediate place, "compound" when there are *more* than one.

All questions in this rule may be solved by one or more proportions.

## SIMPLE ARBITRATION OF EXCHANGES.

Given the *course* of exchange between each of two places and a third, to find the par of exchange between the former.

## RULE.

Make the given sums of money belonging to the third place the first and second terms of the proportion; and put as third term the equivalent of what is in the first. The fourth proportional will be the value of what is in the second term in the kind of money contained in the third term.

## EXAMPLE.

If London exchanges with Paris at 10*d.* per franc, and with Amsterdam at 34*s.* 8*d.* per pound sterling, what ought to be the course of exchange between Paris and Amsterdam, that a merchant may without loss remit from London to Amsterdam through Paris?

£1 : 10*d.* :: 34*s.* 8*d.* (the equivalent in Flemish money of £1) : ?  
the equivalent of 10*d.* British (or of a franc) in Flemish money;

Or 240 : 10 :: 34*s.* 8*d.* :  $\frac{34s. 8d. \times 10}{240} = 17\frac{1}{2}d.$  the required  
value of 10*d.* British, or of a franc, in Flemish money.

1*l.* and 10*d.* are the two given sums of English money, or that which belongs to the *third* place; and 34*s.* 8*d.* is the given equivalent of 1*l.*

1. If the exchange between London and Amsterdam is 33*s.* 9*d.* per pound sterling, and the exchange between London and Paris 9½*d.* per franc, what is the par of exchange between Amsterdam and Paris?

## COMPOUND ARBITRATION OF EXCHANGES.

To find what should be the course of exchange between two places, through two or more others, that it may be on a par with the course of exchange between the same two places directly.

## RULE.

Having reduced monies of the same kind to the same denomination, consider each course of exchange as a ratio; set

down the different ratios in a vertical column, so that the antecedent of the second shall be of the same kind as the consequent of the first, and the antecedent of the third of the same kind as the consequent of the second—putting down a note of interrogation for the unknown term of the imperfect ratio. Then divide the product of the consequents by the product of the antecedents, and the quotient will be the value of the given sum if remitted through the intermediate places.

Compare with this its value as remitted by the direct exchange.

### EXAMPLE.

824*l.* Flemish being due to me at Amsterdam, it is remitted to France at 16*d.* Flemish per franc; from France to Venice at 300 francs per 60 ducats; from Venice to Hamburgh at 100*d.* per ducat; from Hamburgh to Lisbon at 50*d.* per 400 rees; and from Lisbon to England at 5*s.* 8*d.* sterling per milree. Shall I gain or lose, and how much, the exchange between England and Amsterdam being 34*s.* 4*d.* per *l.* sterling?

16 <i>d.</i>	-	-	:	1 franc.
300 ducats	-	-	:	60 ducats.
1 ducat	-	-	:	100 pence Flemish.
50 pence Flemish	:	400		Rees.
1000 rees	-	-	:	68 pence British.
	-	-	:	£824 Flemish.

$$\frac{1 \times 60 \times 100 \times 400 \times 68 \times 824}{16 \times 300 \times 1 \times 50 \times 1000} = \text{if we reduce}$$

$$\text{the terms } \frac{17 \times 824}{25} = £560 \ 6 \ 4\frac{1}{2}.$$

But the exchange between England and Amsterdam for 824*l.* Flemish is 480*l.* sterling.

$$\text{Since } 34\text{s. } 4\text{d.} : £824 :: £1 : \frac{824}{34\text{s. } 4\text{d.}} = £480.$$

I gain therefore by the circular exchange 560*l.* 6*s.* 4½*d.* minus 480*l.* = 80*l.* 6*s.* 4½*d.*

If commission is charged in any of the places, it must be deducted from the value of the sum which can be obtained in that place.

The process given for the Compound Arbitration of Exchange may be proved to be correct by putting down the

different proportions and solving them in succession. Thus, if 16*d.* are equal to 1 franc, what will 300 francs (= 60 ducats) be worth? If the quantity last found is the value of 60 ducats, what will be that of one ducat (= 100*d.*), &c.

2. If London would remit 1000*l.* sterling to Spain, the direct exchange being 42½*d.* per piastre of 272 maravedis; it is asked whether it will be more profitable to remit directly, or to remit first to Holland at 35*s.* per pound; thence to France at 19½*d.* per franc; thence to Venice at 300 francs per 60 ducats; and thence to Spain at 360 maravedis per ducat?

To estimate the gain or loss per cent.

#### RULE.

As the par of exchange is to the course of exchange, so is 100*l.* to a fourth proportional. From this subtract 100*l.*

#### EXAMPLE.

The par of exchange is found to be 18½*d.* Flemish, but the course of exchange is 19*d.* per franc; what is the gain per cent.?

$$18\frac{1}{2} : 19d. :: £100 : \frac{£19 \times £100}{18\frac{1}{2}} = £104\ 7s. 11d.$$

Thus the gain per cent. = 104*l.* 7*s.* 11*d.* minus 100*l.* = 4*l.* 7*s.* 11*d.* if the merchant remits through Paris.

If in remitting through Paris commission must be paid, it is deducted from the gain.

3. The par of exchange is found to be 18½*d.* Flemish, but the course of exchange is 19½*d.*; what is the gain per cent.?

4. The par of exchange is 18½*d.* Flemish, but the course of exchange is 17½*d.* what is the loss per cent.?

#### QUESTIONS FOR THE PUPIL.

What is meant by arbitration of exchanges?

What is the difference between simple and compound arbitration?

What is the rule for simple arbitration?

How are we to act if commission is charged in any place?

How is the gain or loss per cent. estimated?

## PROFIT AND LOSS.

By this rule we are enabled to discover how much we gain or lose in mercantile transactions when we sell at certain prices.

Given the prime cost and selling price, to find the gain or loss in a certain quantity.

### RULE.

Find the price of the goods at prime cost and at the selling price; the difference will be the gain or loss on a given quantity.

### EXAMPLE.

What do I gain if I buy 460 lbs. of cheese at 6*d.* and sell it at 7*d.* per lb.?

The total prime cost of 460 lb. @ 6*d.* is = 2760*d.*

The total selling price of 460 lb. @ 7*d.* is = 3220*d.*

The difference or gain on 460 lb. is = 460*d.* = £1 18*s.* 4*d.*

1. Bought 140 lbs. of butter at 10*d.* per lb., and sold it at 1*s.* 2*d.* per lb.; what was gained?

2. Bought 5 cwt. 3 qrs. 14 lbs. of cheese at 2*l.* 12*s.* per cwt., and sold for 2*l.* 18*s.* per cwt.; what was the gain on the whole?

3. If a chest of tea containing 144 lbs. is bought for 6*s.* 8*d.* per lb., what is the gain, the price received for the whole being 57*l.* 10*s.*?

To find the gain or loss per cent.

### RULE.

As the cost is to the selling price, so is 100*l.* to the required sum. The fourth proportional minus 100*l.* will be the gain per cent.

### EXAMPLES.

1. What do I gain per cent. if I buy 1460 lbs. of rice at 3*d.* and sell it at 3½*d.* per lb.?

3*d.* × 1460 = 4380 the cost price. 3½*d.* × 1460 = 5110 the selling price.

4380 : 5110 :: 100 :  $\frac{5110 \times 100}{4380} = £116 \text{ 18s. 4d.} - £100$  (= £16 18*s.* 4*d.*) is the gain per cent.

2. A person sells a horse for 40*l.*, and loses 9 per cent., while he should have made 20 per cent.; what is his entire loss?

100*l.* minus the loss per cent. is to 100*l.* as 40*l.* (what the horse cost minus what he lost by it) is to what it cost.

£91 : £100 :: 40 :  $\frac{100 \times 40}{91} = £43\ 19s.\ 1\frac{1}{2}d.$ , what the horse cost.

But the person should have gained 20 per cent., or  $\frac{1}{5}$  of the price: therefore his profit should have been  $\frac{£43\ 19s.\ 1\frac{1}{2}d.}{5} = £8\ 15s.\ 9\frac{3}{4}d.$

£	s.	d.	
3	19	1 $\frac{1}{2}$	is the difference between cost and selling price.
8	15	9 $\frac{3}{4}$	is what he should have received above cost.

£12 14 11 $\frac{1}{4}$  is his total loss.

4. Bought mutton at 6*d.* per lb., and sold it at 8*d.*; what was the gain per cent.?

5. Bought tea for 5*s.* per lb., and sold it at 3*s.*; what was the loss per cent.?

6. If 5 cwt. 3 qrs. 26 lbs. are bought for 9*l.* 8*s.* and sold for 11*l.* 18*s.* 11*d.*, how much is gained per cent.?

7. Bought a tun of wine for 50*l.* ready money, and sold it for 54*l.* 10*s.* payable in 8 months; how much per cent. per annum is gained by that rate?

If when I sell cloth at 7*s.* per yard I gain 10 per cent., what shall I gain per cent. when it is sold for 8*s.* 6*d.*?

7*s.* : 8*s.* 6*d.* :: £110 : £133 11*s.* 5 $\frac{1}{2}$ *d.* And £133 11*s.* 5 $\frac{1}{2}$ *d.* - £100 = £33 11*s.* 5 $\frac{1}{2}$ *d.* is the required sum.

8. Having sold 2 yards of cloth for 11*s.* 6*d.* I gained at the rate of 15 per cent.; what should I have gained if I had sold for 12*s.*?

Given the cost price and gain, to find the selling price.

#### RULE.

As 100*l.* is to 100*l.* plus the gain per cent., so is the cost price to the required selling price.

#### EXAMPLE.

At what price per yard must I sell 427 yards of cloth

which I bought for 19s. per yard so that I may gain 8 per cent. ?

$$100 : 108 :: 19s. \frac{108 \times 19s.}{100} = £1 \ 0s. \ 6\frac{1}{2}d.$$

This result may be proved by the last rule.

9. Bought velvet at 4s. 8d. per yard ; at what price must I sell it, so as to gain 12½ per cent ?

10. A merchant receives 180 casks of plums which cost him 16s. each cask, and trades then against other merchandise at 28s. per cwt., by which he finds he has gained 25 per cent ; what, on an average, was the weight of each cask ?

Given the gain, or loss per cent., and the selling price to find the cost price.

#### RULE.

As 100l. plus the gain (or as 100l. minus the loss) is to 100l., so is the selling to the cost price.

#### EXAMPLES.

1. If I sell 72 lbs. of tea at 6s. per lb., and gain 9 per cent., what did it cost per lb. ?

$$109 : 100 :: 6 : \frac{6s. \times 100}{109} = 5s. \ 6d.$$

What produces 109l. cost 100l. ; therefore, what produces 6s. must, at the same rate, cost 5s. 6d.

2. A merchant buys 97 casks of raisins at 30s. each, and selling them at 4l. per cwt. makes 20 per cent. ; for how much did he buy it per cwt. ?

$$30s. \times 97 = 2910s. \text{ the total price.}$$

$$\text{Then } 100 : 120 :: 2910 : \frac{2910s. \times 120}{100} = 3492s. \text{ the selling}$$

$$\text{price. And } \frac{3492s.}{80s.} \left( = \frac{3492s.}{£4} \right) = 43.65 \text{ is the number of cwts., and}$$

$$\frac{43.65}{97 \text{ lb.}} \ 50.4 \text{ lb., is the average weight of each cask.}$$

$$\text{Then } 50 \text{ lb. } \frac{194}{485} : 112 \text{ lb.} :: 30s. : \frac{112s. \times 30}{50.4} = 66s. \ 8d. \\ = £3 \ 6s. \ 8d. \text{ the required cost price, per cwt.}$$

11. Having sold 12 yards of cloth at 20s. per yard, and lost 10 per cent., what was the prime-cost ?

12. Having sold 12 yards of cloth at 20s. per yard, and gained 10 per cent., what was the prime cost?

13. Having sold 12 yards of cloth for 5l. 14s., and gained 8 per cent., what was the prime cost per yard?

#### QUESTIONS FOR THE PUPIL.

What is the object of the rule?

Given the prime cost and selling price, how is the profit or loss found?

How do we find the profit or loss per cent.?

Given the prime cost and gain, how is the selling price found?

Given the gain or loss per cent., and selling price, how do we find the cost price?

#### PARTNERSHIP OR FELLOWSHIP.

This rule enables us, when two or more persons are joined in partnership, to estimate the amount of profit or loss which belongs to the share of each.

Fellowship is either *single* (simple) or *double* (compound). It is *single*, or simple fellowship, when the different stocks have been in trade for the same time. It is *double*, or compound fellowship, when the different stocks have been employed for *different* times.

This rule also enables us to estimate how much of a bankrupt's stock is to be given to each creditor.

#### RULE.

*Single Fellowship.*—As the whole stock is to the whole gain or loss, so is each person's contribution to the gain or loss which belongs to him.

#### EXAMPLE.

A put 720l. into trade, B 340l., and C 960l.; and they gained 47l. by the traffic: what is B's share of it?

$$\begin{array}{r}
 \text{£} \\
 720 \\
 340 \\
 960 \\
 \hline
 2020
 \end{array}
 : \text{£}47 :: \text{£}340 : \frac{47 \times 340}{2020} = \text{£}7 \text{ 18s. } 2\frac{1}{2}\text{d.}$$

Each person's gain or loss, must evidently be proportional to his contribu-



1. A and B buy certain goods, amounting to 80*l.*, of which A pays 30*l.*, and B 50*l.*, and they gain 20*l.*; how is it to be divided?

2. A merchant failing, owes to E 500*l.*, and to H 900*l.*, but has only 1100*l.* to meet these demands; how much should each creditor receive?

3. Three persons are to pay a tax of 100*l.* according to their estates. B's yearly property is 800*l.*, C's 600*l.*, and D's 400*l.*; how much is each person's share?

4. Three farmers hold a farm in common; one pays 97*l.* for his portion, another 79*l.*, and the third 100*l.*. The county cess on the farm amounts to 34*l.*; what is each person's share of it?

#### RULE.

*Compound Fellowship.*—Multiply each person's stock by the time during which it has been in trade, and say, as the sum of the products is to the whole gain or loss, so is each person's product to his share of the gain or loss.

#### EXAMPLE.

A contributes 30*l.* for 6 months, B 84*l.* for 11 months, and C 96*l.* for 8 months, and they lose 14*l.*; what is C's share of this loss?

$$\begin{array}{rcl} 30 \times 6 & = & 180 \text{ for one month} \\ 84 \times 11 & = & 924 \quad \text{,,} \\ 96 \times 8 & = & 768 \quad \text{,,} \end{array} \quad \left. \vphantom{\begin{array}{rcl} 30 \times 6 \\ 84 \times 11 \\ 96 \times 8 \end{array}} \right\} = £1872 \text{ for one month.}$$

$$1872 : £14 :: £768 : \frac{£14 \times 768}{1872} = £5 \text{ } 14\text{s. } 10\frac{1}{2}\text{d. C's share.}$$

5. Three merchants enter into partnership: B puts in 89*l.* 5*s.* for 5 months, C. 92*l.* 15*s.* for 7 months, and D 38*l.* 10*s.* for 11 months, and they gain 86*l.* 16*s.*; what should be each person's share of it?

6. Three dealers, A, B, and C, enter into partnership, and in a certain time make 291*l.* 13*s.* 4*d.* A's stock, 150*l.*, was in trade 6 months; B's, 200*l.*, 3 months; and C's, 125*l.*, 16 months: what is each person's share of the gain?

7. O, Y, and X, form a company: O's stock is in trade 3 months, and he claims  $\frac{1}{3}$  of the gain; Y's stock is 6 months in trade; and X advanced 756*l.* for 4 months, and claims half the profit: how much did O and Y contribute?

Ans. O 168*l.*, and Y 288*l.*

It follows that Y's gain was  $\frac{5}{12}$ . Then  $\frac{1}{3} : \frac{1}{12} :: 756\text{£} \times 4 : 504\text{£} = \text{O's product}$ , which being divided by his number of months will give 168£ as his contribution. Y's share of the stock may be found in the same way.

8. Three merchants are concerned in a steam vessel: the first, A, puts in 240£. for 6 months; the second, B, a sum unknown for 12 months: and the third, C, 160£. for a time not known. When the accounts were settled, A received 300£. for his stock and profit, B 600£. for his, and C 260£. for his; what was B's stock, and C's time?

Ans. B's stock was 400£.; and C's time 15 months.

If 300£. arise from 240£. in 6 months, 600£. (B's stock and profit) will be found to arise from 400£. (B's stock) in 12 months.

Then 400£. : 160£. :: 200£. (the profit on 400£. in 12 months) : 80£. (the profit on 160£. in 12 months); and 80£. (the profit on a certain sum for 12 months) : 100£. (the profit on the same sum, for another time) :: (the number of months

in one case) :  $\frac{100 \times 12}{80}$  (the number of months in the other case) = 15, the number of months required to produce the difference between 160£., C's stock, and the 260£. which he received.

9. In the preceding question A's gain was 60£. during 6 months, B's 200£. during 12 months, and C's 100£. during 15 months; and the sum of the product of their stocks and time is 8640£.: what were their stocks?

### QUESTIONS.

What is Fellowship?

What is the difference between single and double fellowship; and are these ever called by any other names?

What are the rules for single and double fellowship?

### BARTER.

Barter enables the merchant to exchange one commodity for another, without either gain or loss.

### RULE.

Find the price of the given quantity of one kind of mer-

chandise to be bartered, and then ascertain how much of the other kind this price ought to purchase.

### EXAMPLES.

1. How much tea at 8s. per lb. ought to be given for 3 cwt. of tallow, at 1*l.* 16s. 8*d.* per cwt.?

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 1 \quad 16 \quad 8 \\ \hline \quad \quad 8 \end{array}$$

5 10 0 is the price of 3 cwt. of tallow, and  $\text{£}5 \text{ 10s. } \div 8 = 18\frac{1}{2}$  the number of pounds of tea which  $\text{£}5 \text{ 10s.}$ , the price of the tallow, would purchase.

2. I wish to barter 96 lbs. of sugar, which cost me 8*d.* per lb., but which I sell at 13*d.*, giving 9 months' credit, for calico which another merchant sells for 17*d.* per yard, giving 6 months' credit; how much calico should I receive?

I first find out at what price I could sell the sugar were I to give the same credit as he does.

If 9 months' credit give me 5*d.* profit, what ought 6 months to give me?

$$9 : 6 :: 5 : \frac{6 \times 5}{9} = \frac{30}{9} = 3\frac{1}{3}\text{d.}$$

Hence, were I to give 6 months' credit, I should charge  $11\frac{1}{3}$  per lb.

Next, as my selling price is to my buying price, so ought his selling to be to his buying price, both giving the same credit.

$$11\frac{1}{3} : 8 :: 17 : \frac{8 \times 17}{11\frac{1}{3}} \text{ 12d.}$$

The price of my sugar, therefore, is  $96 \times 8\text{d.}$  or 768*d.*; and of his calico, 12*d.* per yard.

$$\text{Hence } \frac{768}{12} = 64 \text{ is the required number of yards.}$$

1. A has silk at 14s. per lb.; B has cloth at 12s. 6*d.*, which cost only 10s. the yard; how much must A charge for his silk, to make his profit equal to that of B?

2. A has coffee which he barter at 6*d.* the lb. more than it cost him, against tea, which stands B in 3s. 2*d.*, but which he rates at 4s. 6*d.* per lb.; how much did the coffee cost at first?

have cloth at 8*d.* the yard, and in barter charge for it and give 9 months' time for payment; another merchant's goods which cost him 12*d.* per lb., and with which 6 months' time for payment; how high must he bid his goods to make an equal barter?  
 Barter goods which cost 8*d.* per lb., but for which I bid 13*d.*, giving 9 months' time, for goods which are bid at 17*d.*, and with which 6 months' time are given. Find the cost of what I receive.

QUESTIONS.

What is Barter?  
 What is the rule for barter?

ALLIGATION.

This rule enables us to find what mixture will be produced by the union of certain ingredients, and then it is called *Alligation Medial*; or what ingredients will be required to produce a mixture—when it is termed *Alligation alternate*.  
*Alligation Medial*.—Given the rates or kinds and quantities of ingredients, to find the mixture they will produce.

RULE.

Multiply the rate or kind of each ingredient by its amount; add the sum of the products by the number of the lowest denomination contained in the whole quantity, and the quotient will be the rate or kind of that denomination of the mixture.  
 From this may be found the rate or kind of any other denomination.

EXAMPLES.

What ought to be the price per lb. of a mixture containing 9 lbs. of sugar at 9*d.* per lb., 87 lbs. at 5*d.*, and 34 lbs.

<i>d.</i>	<i>d.</i>
9 × 98 =	882
87 × 5 =	435
34 × 34 =	204

---


$$219 \div 1521 = 7d. \text{ per lb. nearly.}$$

What will be the price per lb. of a mixture containing

9 lbs. 6 oz. of tea at 5s. 6d. per lb., 18 lbs. at 6s. per lb., and 46 lbs. 3 oz. at 9s. 4½d. per lb.?

lb.	oz.		s.	d.		£	s.	d.
9	6	at	5	6	per lb.	2	11	6½
18	0	"	6	0	"	5	8	0
46	3	"	9	4½	"	21	12	10½
<hr/>						<hr/>		
53	9	=	1177 ozs.		÷	29	12	5½ = 6d. per oz. nearly, or 8s. per pound.

3. A goldsmith has 3 lbs. of gold 22 carats fine, and 2 lbs. 21 carats fine, what will be the fineness of the mixture?

In this case the value of each kind of ingredient is represented by a number of carats.

$$\begin{array}{rcl}
 \text{lb.} & & \\
 3 \times 22 & = & 66 \\
 2 \times 21 & = & 42 \\
 \hline
 5 & & 5 \overline{) 108}
 \end{array}$$

The mixture is 21½ carats fine.

1. A vintner mixed 2 gallons of wine, at 14s. per gallon, with 1 gallon at 12s., 2 gallons at 9s., and 4 gallons at 8s. what is one gallon of the mixture worth?

2. 17 gallons of ale at 9d. per gallon, 14 at 7½d., 5 at 9½d. and 21 at 4½d. are mixed together; how much per gallon is the mixture worth?

3. Having melted together 7 oz. of gold 22 carats fine, 12½ oz. 21 carats fine, and 17 oz. 19 carats fine, what is the fineness of each ounce of the mixture?

*Alligation Alternate.*—Given the nature of the mixture, and of the ingredients, to find the relative amounts of the latter.

#### RULE.

Put down the quantities *greater* than the given mean (each of them connected with the difference between it and the mean, by the sign —) in one column; put the differences between the remaining quantities and the mean (connected with the quantities to which they belong, by the sign +) in a column to the right hand of the former. Unite, by a line, each plus with some minus difference; and then each difference will express how much of the quantity, with whose difference it is connected, should be taken to form the required mixture.

If any difference is connected with *more than one* other difference, it is to be considered as *repeated* for each of the differences with which it is connected; and the sum of the differences with which it is connected is to be taken as the required amount of the quantity whose difference it is.

EXAMPLES.

1. How many pounds of tea at 5*s.* and 8*s.* per lb. would form a mixture worth 7*s.* per lb.?

Price.                      Differences.                      Price.

The mean 8*s.*—1*s.*

2*s.* + 5*s.* the mean.

Answer.—1 lb. at 5*s.* per lb., and 2 at 8*s.* per lb., will form a mixture worth 7*s.*

2. How much sugar at 9*d.*, 7*d.*, 5*d.*, and 10*d.*, will produce sugar at 8*d.* per lb.?

Prices.                      Differences.                      Prices.

$$\text{The mean} = \left\{ \begin{array}{cc} \overset{d.}{9} & - \overset{d.}{1} \\ \underset{10}{10} & - \underset{2}{2} \end{array} \right\} \quad \begin{array}{cc} \overset{d.}{1} & + \\ \underset{3}{3} & + \end{array} \left\{ \begin{array}{c} \overset{d.}{7} \\ \underset{5}{5} \end{array} \right\} = \text{the mean}$$

lb.                      *d.*  
 1 at 7  
 2 " 5  
 1 " 9  
 3 " 10 } will produce a mixture worth 8*d.*

3. What quantity of tea at 4*s.*, 6*s.*, 8*s.*, and 9*s.* per lb. will produce a mixture worth 5*s.*?

Prices.                      Differences.                      Prices.

$$\text{The mean} = \left\{ \begin{array}{cc} \overset{s.}{8} & - \overset{s.}{3} \\ \underset{6}{6} & - \underset{1}{1} \\ \underset{9}{9} & - \underset{4}{4} \end{array} \right\} \quad \begin{array}{c} - \\ - \\ - \end{array} \quad \begin{array}{c} 1s. + 4s. = \text{the mean.} \\ \text{One pound of each required.} \end{array}$$

4. How much of anything at 3*s.*, 4*s.*, 5*s.*, 7*s.*, 8*s.*, 9*s.*, 11*s.*, and 12*s.* per lb. would form a mixture worth 6*s.* per lb.?

Prices.                      Differences.                      Prices.

$$\begin{array}{cc} \overset{s.}{7} & - \overset{s.}{1} \\ \overset{s.}{8} & - \overset{s.}{2} \\ \overset{s.}{9} & - \overset{s.}{3} \\ \overset{s.}{11} & - \overset{s.}{5} \\ \overset{s.}{12} & - \overset{s.}{6} \end{array} \left\{ \begin{array}{c} \\ \\ \\ \\ \end{array} \right\} \quad \begin{array}{cc} \overset{s.}{8} & + \overset{s.}{3} \\ \overset{s.}{2} & + \overset{s.}{4} \\ & 1 + 5 \end{array}$$

1 lb. at 3*s.*, 2 lbs. at 4*s.*, 14 lbs. at 5*s.*, 3 lbs. at 7*s.*, 2 lbs. at 8*s.*, 1 lb. at 9*s.*, 1 lb. at 11*s.*, and 1 lb. at 12*s.* per lb., will form the required mixture?

How much wine at 8*s.* 6*d.* and 9*s.* per gallon will make a mixture worth 8*s.* 10*d.* per gallon?

5. How much tea at 6*s.* and at 3*s.* 8*d.* per lb. will make a mixture worth 4*s.* 4*d.* per lb.?

6. A grocer has sugar at 5*d.*, 7*d.*, 12*d.*, and 13*d.* per lb., how much of each kind will form a mixture worth 10*d.* per lb.?

When a given amount of the mixture is required, to find the corresponding amounts of the ingredients.

### RULE.

Find the amount of each ingredient by the last rule. Then add the amounts together, and say, as their sum is to the amount of any one of them, so is the required quantity of the mixture to the corresponding amount of that one.

### EXAMPLE.

What must be the amount of tea at 4*s.* per lb. in 736 lbs. of a mixture worth 5*s.* per lb. and containing tea at 6*s.*, 8*s.*, and 9*s.* per lb. To produce a mixture worth 5*s.* per lb. we require 8 lbs. at 4*s.*, 1 at 8*s.*, 1 at 6*s.*, and 1 at 9*s.* per lb. But all of these added together will make 11 lbs., in which there are 8 lbs. at 4*s.*?

Therefore  $\begin{array}{ccccccc} \text{lb.} & \text{lb.} & & \text{lb.} & & \text{lb.} & \text{oz.} \\ 11 & : & 8 & :: & 736 & : & \frac{8 \times 736}{11} = 536 \frac{2}{11} \end{array}$  the required quantity of tea at 4*s.*

That is, in 736 lbs. of the mixture there will be 536  $\frac{2}{11}$  oz. at 4*s.* per lb. The amount of each of the other ingredients may be found in the same way.

7. 27 lbs. of a mixture worth 4*s.* 4*d.* per lb. are required. It is to contain tea at 5*s.* and at 3*s.* 6*d.* per lb.; how much of each must be used?

8. How much sugar at 4*d.*, 6*d.*, and 8*d.* per lb. must there be in 1 cwt. of mixture worth 7*d.* per lb.?

9. How much brandy at 12*s.*, 13*s.*, 14*s.*, and 14*s.* 6*d.* per gallon must there be in one hog-head of a mixture worth 13*s.* 6*d.* per gallon?

When the amount of one or more of the ingredients is given, to find that of the other:

### RULE.

As the amount of one ingredient (found by the rule) is to the given amount of the same ingredient, so is the amount of the other ingredient (found by the rule) to the required quantity of that of the other.

### EXAMPLE.

29 lbs. of tea at 4s. per lb. is to be mixed with teas at 6s., 8s., and 9s. per lb. so as to produce what will be worth 5s. per lb.; what quantities must be used?

8 lbs. at 4s., 1 lb. at 8s. and at 6s., 1 lb. at 9s. will make a mixture worth 5s. per lb.; therefore, 8 lbs. the quantity of tea at 4s. per lb. (as found by the rule): 29 lbs. (the given quantity of the same tea) :: 1 lb. (the quantity of tea at 6s. per lb. as found by the rule) :  $\frac{1 \times 29}{8}$  (the quantity of tea at 6s., which

corresponds with 29 lbs. at 4s. per lb.) =  $3\frac{1}{8}$ .

We may in the same manner find what quantities of tea at 8s. and 9s. per lb. correspond with 29 lbs., the given amount of tea at 4s. per lb.

10. How much tea at 6s. per lb. must be mixed with 12 lbs. at 3s. 8d. per lb. so that the mixture may be worth 4s. 4d. per lb.?

### QUESTIONS FOR THE PUPIL.

What is Alligation medial?

What is Alligation alternate?

What is the rule for each of these?

What is the rule when a certain amount of the mixture is required?

What is the rule when the amount of one or more of the ingredients is given?

### INVOLUTION AND EVOLUTION.

When a number is multiplied by itself, the product is called the power, and the number multiplied the root. Thus  $2 \times 2 = 4$ ; here 4 is the square or second power of the root 2. Again,  $2 \times 2 \times 2 = 8$ ; here 8 is the cube or third



power of the root 2. Again  $2 \times 2 \times 2 \times 2 = 16$ ; here 16 is the fourth power of the root 2.

In place of setting down all the factors we put down only one of them, and mark how often they are *supposed* to be set down by a small figure, which, since it *points* out the number of the factors, is called the *index* or *exponent*. Thus,  $5^2$  is the abbreviation for  $5 \times 5$ ; and 2 is the index.  $5^5$  means  $5 \times 5 \times 5 \times 5 \times 5$ , or 5 in the fifth power.  $3^4$  means  $3 \times 3 \times 3 \times 3$ , or 3 in the 4th power.  $8^7$  means  $8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8$ , or 8 in the seventh power, &c.

Sometimes the vinculum is used in conjunction with the index thus,  $5 \times 8^2$ , or  $(5 \times 8)^2$ , means that the sum of 5 and 8 is to be raised to the second power. This is very different from  $5^2 + 8^2$ , which means the sum of the squares of 5 and 8;  $5^2 + 8^2$  being 169; while  $5^2 \times 8^2$  is only 89.

To raise a number to any power.

#### RULE.

Find the product of so many factors as the index of the proposed power contains units, each of the factors being the number which is to be involved.

#### EXAMPLE.

What is the 5th power of 7?

$$7^5 = 7 \times 7 \times 7 \times 7 \times 7 = 16807.$$

The process may be shortened by using one or more of the products already obtained.

#### EXERCISES.

- (1)  $3^2$ . (2)  $20^{10}$ . (3)  $3^7$ . (4)  $105^3$ . (5)  $1.05^2$ .

To raise a fraction to any power.

#### RULE.

Raise both numerator and denominator to that power.

#### EXAMPLE.

$$\left(\frac{2}{3}\right)^3 = \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} = \frac{8}{27}.$$

#### EXERCISES.

- (6)  $\left(\frac{1}{2}\right)^4$ . (7)  $\left(\frac{3}{4}\right)^7$ . (8)  $\left(\frac{1}{2}\right)^2$ . (9)  $\left(\frac{1}{2}\right)^3$ .

ise a mixed number to any number.

### RULE.

ce it to an improper fraction; and then proceed as in the last rule.

### EXAMPLE.

$$(2\frac{1}{2})^4 = (\frac{5}{2})^4 = \frac{625}{16}.$$

### EXERCISES.

$$(11\frac{1}{2})^2. \quad (11) (3\frac{2}{3})^2. \quad (12) (5\frac{1}{2})^6 \quad (13) (4\frac{1}{2})^7.$$

## EVOLUTION

method of extracting the roots of powers. It is, e, the direct opposite of Involution; by referring to ; will be plain, that the *square root* of a number multiplied itself will produce that number; and that the *cube* multiplied *twice* by itself will produce the number (or of which it is the root.

, also, are expressed by *exponents*—but as these ex- are fractions, the roots are called “*fractional powers*.” ; means the square root of 4;  $4\frac{1}{3}$  the cube root of 4; the seventh root of the fifth power of 4.

are also expressed by  $\sqrt{\phantom{x}}$ , called the radical sign. used alone, it means the square root thus,  $\sqrt{3}$  is the root of 3; but other roots are indicated by a small placed within it—thus,  $\sqrt[3]{5}$ , which means the cube 5.  $\sqrt[3]{7^2}$  ( $7\frac{2}{3}$ ) is the cube root of the square of 7.

1.	2.	3.	4.	5.	6.	7.	8.	9.
1.	4.	9.	16.	25.	36.	49.	64.	81.
1.	8.	27.	64.	125.	216.	343.	512.	729.

tract the square root of any number.

### RULE.

e the given number (106929) into periods of two each, by placing a point over the unit figure, and ry alternate figure towards the left. Find the square of the first period, 10, and place it in the quotient. the square of it, 9, from the first period, and to the er annex the next period, 69, for a dividend. Double

the root already found, 3, for a divisor, and supposing the unit figure, 9, omitted, find how often it, viz. 6, is contained in the dividend. It is contained twice, place the 2 then ~~both~~ in the quotient and the divisor. Multiply by it, 2, the divisor, 62, and subtract the product, 124, from the dividend. Bring down another period, and proceed thus till all the periods are brought down.

If there be a remainder after all the periods are used, periods of ciphers may be annexed; when the result will be decimals. Should there be decimals in the given number, still the pointing is to begin from the units' place of the integers, and a point to be placed over every alternate figure both right and left.

## EXAMPLE.

$$\begin{array}{r}
 106929 \text{ (327 root)} \\
 9 \phantom{000000} \\
 \hline
 62 \phantom{00} ) 169 \phantom{00} \\
 \phantom{00} 124 \phantom{00} \\
 \hline
 647 \phantom{00} ) 4529 \phantom{00} \\
 \phantom{00} 4529 \phantom{00} \\
 \hline
 \phantom{000000}
 \end{array}$$

The square root of a fraction is found by extracting the square root of the numerator for a new numerator, and the root of the denominator for a new denominator. If, however, this cannot be done, let the fraction be reduced to a decimal and the root extracted as before.

## EXERCISES.

Find the square roots of the following numbers.

- |                         |                           |                  |
|-------------------------|---------------------------|------------------|
| (14) 309761             | (15) 6225211              | (16) 1234321     |
| (17) 2052.091           | (18) 4795.257311          | (19) 24674.12641 |
| (20) $\frac{49}{144}$ 1 | (21) $\frac{196}{1369}$ 1 |                  |

## EXTRACTION OF THE THIRD OR CUBE ROOT.

To extract the Cube root of any number is to find a number which when multiplied twice by itself will produce the given number.

## RULE.

Divide the given numbers into period of three figures, beginning at the place of units. Place the cube root of the first period 2, in the quotient, and subtract its cube 8, from the first period, and bring down the next period for a dividend, which is 4812, to find a divisor. Multiply the square of the first figure placed in the quotient by 300 = 1200; find how often this is contained in the dividend, viz. 3 times; place the 3 in the quotient for the second figure of the root. Multiply the part of the root formerly found, viz. 2, by the first figure placed in the root, viz. 3, and the product by 30 = 30; add this and the square of the last figure placed in the root to the divisor, viz. 1200; multiply the sum of these, 389, by the last figure placed in the root, 3, and subtract the product, 4167, from the dividend, 4812; bring down another period for a new dividend, and proceed in the same manner.

## EXAMPLE.

Find the cube root of 12812904.

$$\begin{array}{r}
 12812904 \quad (234 \\
 \underline{8} \\
 4812 \\
 \times 2 = 4 \times 300 = 1200 \\
 \times 3 = 6 \times 30 = 180 \\
 \times 3 = 9 \\
 \hline
 1389 \times 3 = 4167 \\
 \hline
 645904 \\
 23^2 \times 300 = 158700 \\
 23 \times 4 \times 30 = 2760 \\
 4^2 = 16 \\
 \hline
 161476 \times 4 = 645904 \\
 \hline
 0
 \end{array}$$

To extract the cube root of a vulgar fraction reduce it to a decimal, and then extract the root.

In mixed numbers reduce the fractional part to a decimal.

## EXERCISES.

Find the cube root of the following numbers.

- (22) 373248.      (23) 54872.      (24) 389017.      (25) 1092727.  
 (26) 84604519.      (27) 52734375.      (28) 78348748.  
 (29) .053157376.      (30)  $\frac{1}{4}$ .      (31)  $7\frac{1}{8}$ .

## QUESTIONS FOR THE PUPIL.

What are Involution and Evolution?

What are a power, index, and exponent?

What is the meaning of square and cube, of the square and cube roots?

What is the difference between an integral and a fractional index?

How is a number raised to any power?

What is the rule for finding the square root?

What is the rule for finding the cube root?

How is the square or cube root of a fraction or of a mixed number found?

## PROGRESSION.

A progression consists of a number of quantities increasing or decreasing by a certain law, and forming what are called *continued proportionals*. When the terms of the series constantly increase it is said to be an *ascending*, but when they decrease (increase to the left), a *descending series*.

In an *equidifferent* or *arithmetical* progression, the quantities increase, or decrease by a *common difference*. Thus, 5, 7, 9, 11, &c. is an ascending, and 15, 12, 9, 6, &c. is a descending *arithmetical* series or progression. The common difference in the former is 2, and in the latter 3. A continued proportion may be formed out of such a series. Thus—

5 : 7 :: 7 : 9 :: 9 : 11, &c.; and 15 : 12 ::  
12 : 9 :: 9 : 6, &c.; or we may say, 5 : 7 :: 9 :  
11 :: &c.; and 15 : 12 :: 9 : 6 :: &c.

In a *geometrical* or *equirational* progression, the quantities increase by a *common ratio* or multiplier. Thus, 5, 10, 20, 40, &c.; and 10000, 1000, 100, 10, &c. are geometrical series. The common ratio in the former case is 2, and the quantities increase to the right; in the latter it is 10, and the quantities increase to the left. A continued proportion may be formed out of such a series. Thus—

5 : 10 :: 10 : 20 :: 20 : 40, &c.; and 10000 :  
1000 :: 1000 : 100 :: 100 : 10, &c.; or we may say  
5 : 10 :: 20 : 40 :: &c.; and 10000 : 1000 :: 100 :  
10 :: &c.

The first and last term of a progression are called its *extremes*, and all the intermediate terms its *means*.

*Arithmetical Progression.*—To find the sum of a series of terms in arithmetical progression.

**RULE.**

Multiply the sum of the extremes by half the number of terms.

**EXAMPLE.**

What is the sum of a series of 10 terms, the first being 2, and the last 20?

$$2 + 20 \times \frac{10}{2} = 110.$$

This may be proved by setting down the progression twice over, but in such a way as that the last term of one shall be under the first term of the other series.

Then  $24 + 21 + 18 + 15 + 12 + 9 =$  the sum.

$9 + 12 + 15 + 18 + 21 + 24 =$  the sum.

and adding }  $33 + 33 + 33 + 33 + 33 + 33 =$  twice the sum.  
 6 equals

**EXERCISES.**

1. One extreme is 3, the other 15, and the number of terms is 7; what is the sum of the series?

2. One extreme is 5, the other 93, and the number of terms 49; what is the sum?

3. One extreme is 147, the other  $\frac{1}{2}$ , and the number is 97; what is the sum?

Given the extremes, and number of terms, to find the common difference.

**RULE.**

Find the difference between the given extremes and divide by one less than the number of terms. The quotient will be the common difference.

**EXAMPLE.**

In an arithmetical series the extremes are 21 and 3, and the number of terms is 7; what is the common difference?

$$21 - 3 \div 7 - 1 = 18 \div 6 = 3 \text{ the required number.}$$

**EXERCISES.**

4. The extremes of an arithmetical series are 21 and 497, the number of terms is 41; what is the common difference?

5. The extremes of an arithmetical series are  $127\frac{5}{8}$ , and  $9\frac{1}{4}$ , and the number of terms is 26; what is the common difference?

Given the extremes and common difference, to find the number of terms.

#### RULE.

Divide the difference between the given extremes by the common difference, and the quotient plus unity will be the number of terms.

#### EXAMPLE.

How many terms in an arithmetical series of which the extremes are 5 and 26, and the common difference 3?

$$\frac{26 - 5}{3} = 7. \text{ And } 7 + 1 = 8 \text{ is the number of terms.}$$

6. In an arithmetical series, the extremes are 96 and 12 and the common difference is 6; what is the number of terms?

7. In an arithmetical series, the extremes are 14 and 32 and the common difference is 3; what is the number of terms?

*Geometrical Progression.*—Given the extremes and common ratio, to find the sum of the series.

#### RULE.

Subtract the lesser extreme from the product of the greater extreme and the common ratio; and divide the difference by one less than the common ratio.

#### EXAMPLE.

In a geometrical progression, 4 and 312 are the extremes and the common ratio is 2; what is the sum of the series?

$$\frac{312 \times 2 - 4}{2 - 1} = 620 \text{ the required number.}$$

8. The extremes of a geometrical series are 512 and 4 and the common ratio is 4; what is the sum?

9. The clocks in Venice and some other places strike 24 hours, not beginning again as ours do after 12; how many strikes do they give in a day?

10. A butcher bought 100 sheep: for the first he gave 1s., and for the last 9l. 19s.; what did he pay for all, supposing their prices to form an arithmetical series?

11. A person travelling into the country went 3 miles the first day, 8 miles the second, 13 the third, and so on, until he went 58 miles in one day; how many days did he travel?

12. A man, being asked how many sons he had, said that the youngest was 4 years old, and the eldest 32, and that he had added one to his family every fourth year; how many had he?

### QUESTIONS FOR THE PUPIL.

What is meant by ascending and descending series?

What is meant by an arithmetical and a geometrical progression; and are they designated by any other names?

What are the common difference and common ratio?

Show that a continued proportion may be formed from a series of either kind?

What are means and extremes?

How is the sum of an arithmetical or a geometrical series found?

How is the common difference or ratio found?

How is an extreme of an arithmetical or geometrical series found?

### PROMISCUOUS EXERCISES.

1. How much is  $\frac{1}{6}$  of 186 acres 3 roods?
2. How much is  $\frac{4}{9}$  of 15 hours 45 minutes?
3. How much is  $\frac{870}{2219}$  of 19 cwt. 3 qrs. 7 lbs.?
4. What is the simplest form of a fraction expressing the comparative magnitude of two vessels, the one containing 4 tons 3 hhds., and the other 5 tons 2 hhds.?
5. What is the sum of  $\frac{3}{4}$  of a pound and  $\frac{5}{8}$  of a shilling?
6. A boy divided his marbles in the following manner: to A he gave  $\frac{1}{3}$ , to B  $\frac{1}{10}$ , to C  $\frac{1}{6}$ , and to D  $\frac{1}{8}$ , keeping the rest; how many did he give away, and how many did he keep?
7. What is the value of 0.86875l.?
8. What is the value of 0.5375l.?
9. How much is 0.875 of a yard?
10. How much is 0.875 of a gallon?
11. How much is 0.3945 of a day?



12. How much is 0.09375 of an acre?

13. A debt of 120*l.* will be due as follows: 50*l.* in 2 months, 40*l.* in 5 months, and the rest in 7 months; what may the whole be paid together?

14. A debt is to be discharged by paying  $\frac{1}{3}$  in 3 months,  $\frac{1}{4}$  in 5 months, and the rest in 6 months; what is the equated time for the whole?

15. Reduce 873 guilders 11 stivers bank money to current money, agio being  $4\frac{7}{8}$  per cent.?

16. Reduce 1186 guilders 4 stivers 8 pennings current to bank money, agio being  $4\frac{3}{8}$  per cent.?

17. Reduce 2746 dollars 30 cents. to British money at 4*s.*  $3\frac{1}{2}$ *d.* per dollar?

18. In 199*l.* 11*s.* 10*d.* British, how much Flemish money, exchange 34*s.* 9*d.* per pound sterling?

19. Reduce 330*l.* to francs, &c., at 23 francs 25 centimes per pound sterling?

20. Reduce 809*l.* 9*s.* 8*d.* to piastres, &c., at 40 $\frac{3}{4}$ *d.* per piastre?

21. Reduce 589*l.* 6*s.*  $2\frac{1}{2}$ *d.* to dollars at 4*s.*  $3\frac{1}{2}$ *d.* per dollar.

22. A merchant at London has credit for 680 piastres at Leghorn, for which he can draw directly at 50*d.* per piastre; but choosing to try the circular way, they are by his orders remitted first to Venice at 94 piastres per 100 ducats; thence to Cadiz at 320 maravedis per ducat; thence to Lisbon at 630 rees per piastre of 272 maravedis; thence to Amsterdam at 50*d.* per crusade of 400 rees; thence to Paris at 18 $\frac{3}{4}$ *d.* per franc; and thence to London at 10 $\frac{1}{2}$ *d.* per franc; how much is the circular remittance better than the direct draft, reckoning  $\frac{1}{2}$  per cent. for commission?

23. Bought 5 cwt. 3 qrs. 14 lbs. of bacon at 34*s.* per cwt., and sold it at 36*s.* 4*d.* per cwt.; what was the gain on the whole?

24. When wine is bought at 17*s.* 6*d.* per gallon, and sold for 27*s.* 6*d.*, what is the gain per cent.?

25. Bought hops at 4*l.* 16*s.* per cwt., at what rate must they be sold to lose 15 per cent.?

26. Two persons are to share 100*l.* in the proportions of 2 to B, and 1 to C; what is the share of each?

27. A ship worth 900*l.* is entirely lost;  $\frac{1}{3}$  of it belonged to B,  $\frac{1}{4}$  to C and the rest to D; what should be the loss of each, 540*l.* being received as insurance?

28. Three merchants form a company; B puts 150*l.*, and

260*l.* ; D's share of 62*l.*, which they gained, comes to 16*l.* ; how much of the gain belongs to B, and how much to C ; and what is D's share of the stock ?

29. Three persons have received 665*l.* interest ; B had put 4000*l.* for 12 months, C 3000*l.* for 15 months, and 5000*l.* for 8 months ; how much is each person's part of the interest ?

30. B has 5 tons of butter at 25*l.* 10*s.* per ton, and 10½ tons of tallow, at 33*l.* 15*s.* per ton, which he barter with C, agreeing to receive 150*l.* 1*s.* 6*d.* in ready money and the rest in beef at 21*s.* per barrel ; how many barrels is he to receive ?

31. Two persons barter : A has sugar at 8*d.* per lb., but charges it at 13*d.*, and gives 9 months' time ; B has cocoa at 2*d.* per lb., and charges it at 17*d.* per lb. ; how much time must B give to make the barter equal ?

32. A merchant has sugar at 5*d.*, 10*d.*, 12*d.*, and 16*d.* per lb. ; how many pounds of each will form a mixture worth 1*d.* per lb. ?

33. A druggist is desirous of producing, from drugs at 5*s.*, 7*s.*, 8*s.*, and 9*s.* per lb., 1½ cwt. of a mixture worth 7*s.* per lb. ; how much of each kind must he use for the purpose ?

34. How much brass at 14*d.* per lb. and pewter at 10½*d.* per lb. must I melt with 50 lbs. of copper at 16*d.* per lb., so to make the mixture worth 1*s.* per lb. ?

35. How much wine at 7*s.* 5*d.*, at 5*s.* 2*d.*, and at 4*s.* 2*d.* per gallon must be mixed with 20 gallons at 6*s.* 8*d.* per gallon, to make the mixture worth 6*s.* per gallon ?

36. What is the square root of 22420225, of 328329, and of 919681 ?

37. What is the cube root of 179597069288 and of  $\frac{2}{3}$  ?

38. One extreme is  $4\frac{3}{8}$ , the other 143, and the number of terms is 42 ; what is the sum ?

39. The extremes of an arithmetical series are  $77\frac{2}{3}$  and 1, and the number of terms is 84 ; what is the common difference ?

40. In an arithmetical series 49 and  $\frac{2}{3}$  are the extremes, and 106 is the number of terms ; what is the 94th term ?

41. The extremes of a geometrical series are 12, and 5692, and the common ratio is 11 ; what is the sum ?

42. A person bought 17 yards of cloth : for the first yard he gave 2*s.*, and for the last 10*s.* ; what was the price of all ?

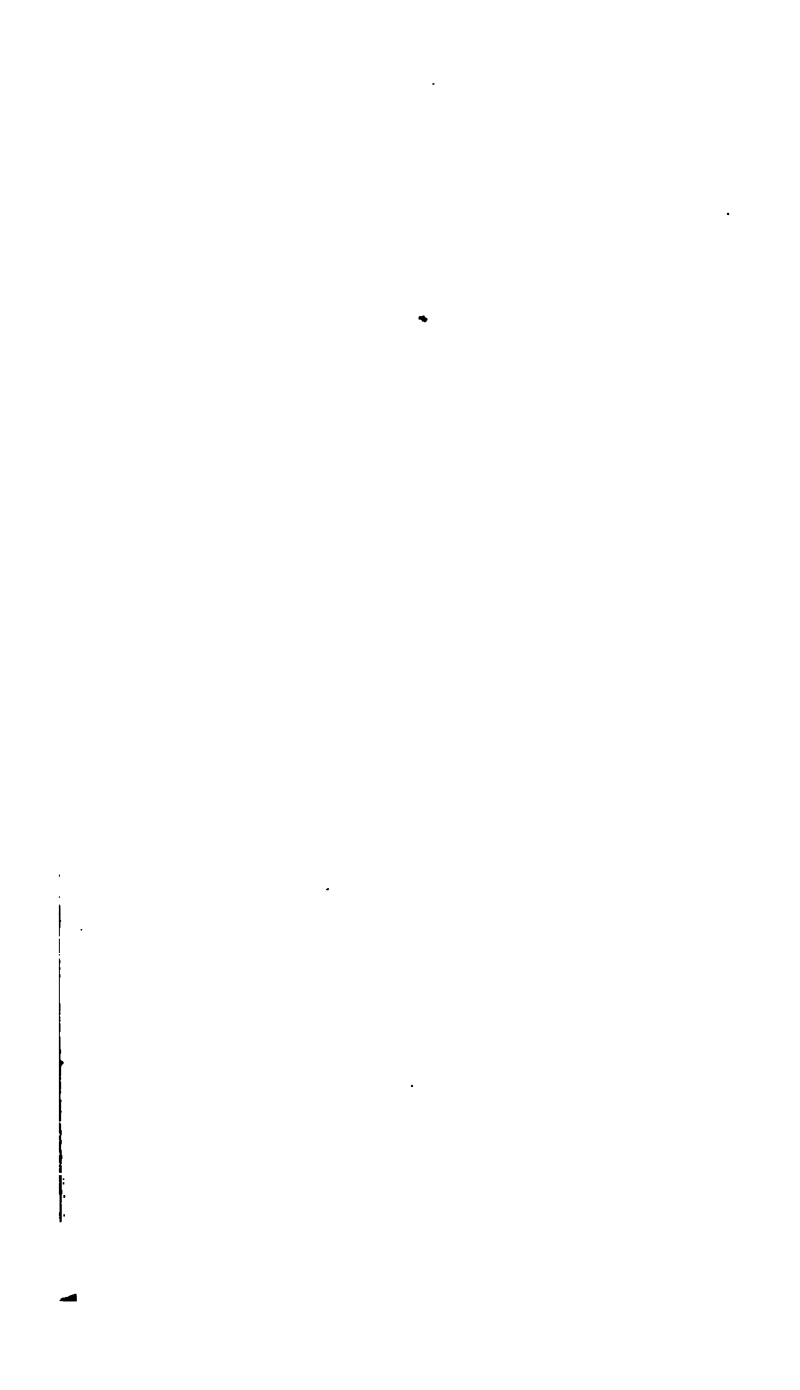
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(2)

Haddon

OFF



*not for 21*  
*17.1/2*  
*(30)*

**K E Y**

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**TO**

**HADDON'S ARITHMETIC,**

*(2)*

**CONTAINING**

*1*

**ANSWERS TO ALL THAT WORK, AND SOLUTIONS OF ALL  
SUCH EXERCISES AS ARE LIKELY TO PRESENT  
ANY DIFFICULTY.**

**BY**

**ABRAHAM ARMAN,**

**SCHOOLMASTER, THURLEIGH, BEDS.**

**LONDON:**

**JAMES S. VIRTUE, CITY ROAD AND IVY LANE.**

**1862.**  
*1/2*



The Answers to the Exercises in Notation are not given, not being considered necessary.

In this work the Exercises in Simple Addition, as far as the 13th, are so constructed as to admit the application of an official test, enabling the teacher to ascertain at a glance the accuracy of the results presented by the pupils.

#### EXAMPLE.

Read—in succession from the top—the figures in the units column, and if you reckon each figure one less as you proceed you will have read the figures of the answer.

Thus—in exercise the 7th, four figures taken from the top of the units column give 5395, which being read each one less, give 4284 the answer.

Note that in these tests 1 less than 0 is reckoned 9 without carrying; accordingly in the 13th exercise the testing figures 307954 are read 296843.





# KEY

TO

## HADDON'S RUDIMENTARY ARITHMETIC.

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*Notation and Numeration, Answers not given in the Key,  
it being considered unnecessary.*

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*Remarks on the Construction of the Exercises in Addition  
(as far as the 13th sum only).*

### TO TEST THE RESULTS IN ADDITION.

Read in succession from the top the figures in the units' column, and if you reckon each figure 1 less as you proceed, you will have read the figures of the Answers.

Thus, in the 4th Exercise, 3 figures taken from the top of the units' column give 468, which being read each one less give 357, the Answer. Note, that (in these Exercises) 1 less than 0 is reckoned 9, without carrying. Accordingly, in the 10th Exercise, the testing figures 59060 are read 48959. This mode may be found occasionally useful to the Teacher, because for these questions there will be no necessity to refer to the Answers in this Key.

## SECTION L

## ADDITION.

No.	ANSWERS.	No.	ANSWERS.
1.	24	13.	296843
2.	27	14.	4257
3.	475	15.	1658286
4.	357	16.	7861214
5.	4736	17.	£57821
6.	2497	18.	2246
7.	4284	19.	204
8.	3278	20.	251
9.	46839	21.	6839
10.	48959	22.	2197
11.	19582	23.	£84
12.	605479		

## SUBTRACTION.

No.	ANSWERS.	No.	ANSWERS.
1.	243523	11.	213899048
2.	318452	12.	99906918
3.	136015	13.	1205995
4.	5304210	14.	359244
5.	35647463	15.	8072
6.	32865265	16.	171
7.	548065820	17.	370
8.	7920856	18.	875334
9.	299932896	19.	78 Years.
10.	98987069		

20 A's houses £3574

B's „ 4770

B the richest man by £1196

## MULTIPLICATION.

## ANSWERS.

114724966  
 38952784  
 177745080  
 81597048  
 158699408  
 92718160  
 21184590  
 89367825  
 562491372  
 83517240  
 32407249  
 3849127380  
 604880784  
 8461523504  
 3227556528  
 57624651  
 399145417  
 52694158  
 6731671008  
 34792368  
 6823648  
 13386366  
 23249952  
 18221409  
 23150412  
 20896344  
 19912230  
 13825056  
 56518416  
 22039992  
 57667632  
 71550144  
 36662276 Units.  
 5237468 Tens.

Product 89036956

## No.

## ANSWERS.

34. 32331654 Units.  
 3592406 Tens.

Product 68255714

35. 862044347 Units.  
 220681449 Tens.

Product 2868858837

36. 68566687 Units.  
 58771446 Tens.  
 9795241 Hundr.

Product 1635805247

37. 11847850 Units.  
 14217420 Tens.  
 7108710 Hundr.

Product 864893050

38. 38348240 Units.  
 239676500 Hundr.

Product 2435113240

39. 1761402 Units.  
 880701 Tens.  
 1174268 Hund.  
 587134 Thow

Product 715129212

No.	ANSWERS.	No.	ANSWERS.
40.	468800000 Hunder. 2344000 Thous.	44.	1172940 I 586470 J 8518820 I 5278230 J
Product	2812800000	Product	5637149640
41.	7168752 Units. 477916800 Thous.	45.	£2720
Product	4786336752	46.	£30492
42.	758944 Units. 948680 Tens. 1517888 Hunder. 1328152 Thous.	47.	1872
Product	1490186544	48.	£3240
43.	3242785 Units. 2594228 Tens. 51884560 Thous.	49.	783
Product	5217641065	50.	80 wi
		51.	1095 I
		52.	56940 I
		53.	768000 I
		54.	111690 I

## DIVISION.

No.	ANSWERS.	No.	ANSWERS.
1.	32659472	15.	4367592—
2.	47953684	16.	5836472—
3.	25273947	17.	630095
4.	26491538	18.	4685357—
5.	21697384	19.	68497075
6.	4654354— 3 rem.	20.	7398628—
7.	97506380	21.	26654—
8.	163740526— 3 rem.	22.	41315—
9.	36852040	23.	40364—
10.	134920238— 1 rem.	24.	24995—
11.	47152698	25.	17862—
12.	185260241— 5 rem.	26.	8703—
13.	472865— 1 rem.	27.	6828—
14.	974863	28.	4408—

ANSWERS.	No.	ANSWERS.
10902—34 rem.	(37) 2864	7198641(2513
1889—64 rem.		5728
3309—88 rem.		<hr/>
3450—76 rem.		14706
		14320
		<hr/>
78)842786(10804		3864
78		2864
<hr/>		<hr/>
627		10001
624		8592
<hr/>		<hr/>
386		1409 remains.
312		<hr/>
<hr/>		
74 remains.		
<hr/>		
946)976842(1032	(38) 26,00	24807,08(954
946		234
<hr/>		<hr/>
3084		140
2838		180
<hr/>		<hr/>
2462		107
1892		101
<hr/>		<hr/>
570 remains.		308 remains.
<hr/>		<hr/>
648)6416879(9902		
5832		
<hr/>		
5848		
5832	(39) 96,00	40202,64(418
1679		384
1296		<hr/>
<hr/>		180
383 remains.		96
<hr/>		<hr/>
4107)2876407(700		842
28749		768
<hr/>		<hr/>
1507 remains.		7464 rema.
<hr/>		

No.	ANSWERS.
(40)	43,0096876,00(2252
	<u>86</u>
	108
	<u>86</u>
	227
	<u>215</u>
	126
	<u>86</u>
	4000 remains.

41.	£702 10s. 0d.
42.	£5000
43.	£29
44.	190 ounces.
45.	£870 15s. 6½d.— $\frac{6}{5}$
46.	36 hours.

No.	ANSWERS.
(47)	495)95173000(192208 miles.
	<u>495</u>
	4567
	<u>4455</u>
	1123
	<u>990</u>
	1330
	<u>990</u>
	3400
	<u>2970</u>
	4300
	<u>3960</u>
	340 remains
	<u>      </u>
(48)	27)25000(925
	<u>243</u>
	70
	<u>54</u>
	160
	<u>135</u>
	25 remains.

COMPOUND ADDITION.

No.	ANSWERS.			
	£	s.	d.	
1.	183	4	11	
2.	201	4	9	
3.	220	10	2	
4.	221	7	8½	
5.	5516	14	2	
6.	822	11	2	
7.	9227	17	10	
8.	28656	4	4	
9.	22440	16	10¾	
10.	32505	1	8½	
11.	20466	4	3½	
12.	6825	7	0¾	
13.	15776	12	9¾	
14.	20002	1	9½	
15.	15565	16	6¾	
16.	13944	2	4½	
17.	2543	0	7	
18.	2170	14	2½	
19.	2352	15	9½	
20.	2421	15	8	
21.	2637	14	5½	
22.	1859	15	0¾	
23.	1068	2	4½	
24.	409	2	9½	

TROY WEIGHT.

	lb.	oz.	dwt.	grs.
25.	21	11	18	0
26.	14	4	19	11
27.	170	1	4	19
28.	15	4	1	14
29.	277	1	4	13
30.	201	0	16	4
31.	139	3	16	0

No.	ANSWERS.			
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AVOIRDUPOIS WEIGHT.

	cwt.	qrs.	lbs.	oz.
32.	128	3	14	0
33.	148	2	15	0
34.	100	0	4	0
35.	173	0	1	0
36.	271	2	11	0
37.	216	1	24	0
38.	1248	1	26	0
39.	1416	0	24	0
40.	2297	2	1	14
41.	3541	3	5	0
42.	2482	0	26	12
43.	26	0	10	11

APOTHECARIES' WEIGHT

	lb.	oz.	drs.	sc.	grs.
44.	80	9	3	0	0
45.	36	1	7	2	0
46.	3	7	3	0	0
47.	4	6	0	1	8

LONG MEASURE.

	pole	yds.	ft.	in.
48.	13	1	1	8
49.	9	7	2	0
	mile	furl.	pole	
50.	12	6	0	
51.	174	3	32	



## No.      ANSWERS.

## SQUARE OR LAND MEASURE.

	a.	r.	p.
52.	150	1	37
53.	167	2	14
	yds.	ft.	in.
54.	98	8	139
55.	85	8	134

## CUBIC MEASURE.

	yds.	ft.	in.
56.	8	8	348
57.	9	4	660

## ALE OR BEER MEASURE.

58. 3 hhd. 17 gal. 1 qt. 1 pt.  
59. 180 bar. 28 gal.

## WINE MEASURE.

	galls.	qts.	pts.	gills
60.	255	0	1	3
61.	200	1	0	1

## DRY MEASURE.

62. 8 wey 1 qr. 6 bush.  
63. 4 bush. 0 pk. 1 gal. 3 qt.

## No.      ANSWERS.

## CLOTH MEASURE.

64. 21 Eng. ells. 3 qrs. 2 nls.  
65. 22 yds. 1 qr. 2 nls.

## TIME MEASURE.

66. 4 yrs. 6 mo. 2 wks. 2 ds.  
67. 3 wks. 6 ds. 19 hrs. 4 m.

## ANGULAR MEASURE.

	deg.	min.	sec.
68.	118	0	51
69.	119	9	41

## COAL MEASURE.

70. 14 st. 3 bush. 1 pk.  
71. 94 chld. 11 sks. 0 bush.

## WOOL WRIGHT.

72. 1 lst. 3 sks. 0 wey 6 tds.  
73. 50 tod 0 cloves 1 pound  
74. £671 12 8½  
75. 103 cwt. 0 qr. 7 lbs.  
76. 21 lbs. 4 oz.  
77. 357 yds. 3 qrs. 2 nls.  
78. 17 tuns 2 hhds.  
79. 471 acres 1 rood 27 pch.  
80. 34 years 6 months.

# COMPOUND SUBTRACTION.

## ANSWERS.

£	s.	d.
3	2	1
0	17	2
0	12	1½
2	2	5½
9	1	5¾
73	15	10½
267	7	7½
199	18	9½
88	0	7½
970	19	5½
437	3	10½
430	18	11½
201	1	2½
544	18	10
1603	14	10½
809	0	10½

## TROY WEIGHT.

lb.	oz.	dwt.	grs.
0	4	18	19
0	6	14	13
28	3	10	21
11	1	6	3

## POIR DUPOIS WEIGHT.

lb. 17 oz. 6 dwt.  
 qr. 6 lb. 13 oz. 12 dwt.  
 cwt. 2 qrs. 1 lb. 12 oz.  
 ton 10 cwt. 1 qr. 22 lb.

## APOTHECARIES' WEIGHT.

lb. 0 oz. 6 dwt. 2 scr.  
 b. 10oz. 7dwt. 0sc. 18gr.  
 b. 7oz. 5dwt. 1sc. 15 gr.

## No.

## ANSWERS.

### LONG MEASURE.

28. 2 mile 6 furl. 25 perches.  
 29. 4 furl. 30 perch. 2½ yds  
 30. 3 perch. 2½ yds. 2 feet  
 31. 2 yds. 11 inches.

### SQUARE OR LAND MEASURE.

	a.	r.	p.
32.	25	2	25
33.	22	1	30
34.	24	2	30
35.	13	2	38

### CUBIC MEASURE.

	yds.	ft.	in.
36.,	13	19	1692
37.	17	24	1616
38.	13	16	526

### LIQUID MEASURE.

39. 22 tuns 229 gals. 4 qts.  
 40. 38 tuns 1 hhd. 60 gals.  
 41. 1 bar. 8 gals. 1 qt. 0½ pt.  
 42. 0 bar. 4 gals. 3 qt. 1 pt.

### DRY MEASURE.

43. 30 qrs. 5 bush. 2 pks.  
 44. 1bsh. 2 pks. 1 gal. 1 pot.  
 45. 3 qrs. 3 bsh. 2 pks. 1 gal.

### CLOTH MEASURE.

46. 17 yds. 2 qrs. 3 nls.  
 47. 2 Flem. ells 1 qr. 3 nls.  
 48. 1 Eng. ell 3 qrs. 2 nls.  
 49. 1 Fr. ell 4 qrs. 3 nls.

## No.      ANSWERS.

## TIME.

50. 18 yrs. 49 wks. 4 days  
 51. 15 yrs. 47 wks. 5 days  
 52. 29 days 15 hrs. 30 min.  
 53. 2 m. 1 w. 4 d. 18 h. 34 m.

## ANGULAR MEASURE.

54. 5 deg. 53 min. 3 sec.  
 55. 3 sgn. 25 deg. 37 m. 29 s.  
 56. 1 s. 26 d. 50 m. 51 s. 59 th.

## COAL MEASURE.

57. 1 chald. 1 sack 1 bush.  
 58. 1 sack 1 bush. 3 pks.

## No.      ANSWERS.

## WOOL WEIGHT.

59. 2 sks. 1 wey 1 tod  
 60. 3 stones 0 clove 8 lbs.  
 61. 15 yds. and £6 15s.  
 62. £58 11s 4d.  
 63. £4166 19s. 6½d.  
 64. 86 tn. 18 cwt. 2 qr. 27 l  
 65. 249 yds. 1 qr. 1 nl.  
 66. 193 acres 37 perches  
 67. 350 hides & 321 cwt. 5 l  
 68. 36 csk. 186 cwt. 3 qr. 15 l

## COMPOUND MULTIPLICATION.

## No.      ANSWERS.

£   s.   d.

1. 399 11 9½  
 2. 412 8 7½  
 3. 306 2 4½  
 4. 463 3 8  
 5. 124 14 8½  
 6. 130 17 7½  
 7. 231 6 11  
 8. 126 5 0¼  
 9. 876 3 9  
 10. 867 3 1¼  
 11. 719 15 6  
 12. 610 11 8¼  
 13. 548 7 8  
 14. 349 6 1¾  
 15. 239 17 4½  
 16. 5322 4 0¼

## No.      ANSWERS.

£   s.   d.

$$(17) \quad \begin{array}{r} 4 \quad 5 \quad 6\frac{1}{2} \times \\ \hline \end{array}$$

$$\begin{array}{r} 17 \quad 2 \quad 2 \\ \hline \end{array}$$

$$\begin{array}{r} \text{£}68 \quad 8 \quad 8 \\ \hline \hline \end{array}$$

$$(18) \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 6 \quad 3 \quad 9 \times \\ \hline \end{array}$$

$$\begin{array}{r} 37 \quad 2 \quad 6 \\ \hline \end{array}$$

$$\begin{array}{r} \text{£}141 \quad 7 \quad 6 \\ \hline \hline \end{array}$$

ANSWERS.	No.	ANSWERS
$\begin{array}{r} \text{£ } s. \text{ d.} \\ 4 \ 16 \ 7 \times 20 \\ \hline 48 \ 5 \ 10 \\ 2 \\ \hline \text{£}96 \ 11 \ 8 \end{array}$	(23)	$\begin{array}{r} \text{£ } s. \text{ d.} \\ 2 \ 17 \ 6 \times 35 \\ \hline 17 \ 5 \ 0 \\ 6 \\ \hline \text{£}108 \ 10 \ 0 \end{array}$
$\begin{array}{r} \text{£ } s. \text{ d.} \\ 5 \ 14 \ 6\frac{1}{2} \times 22 \\ \hline 62 \ 19 \ 11\frac{1}{2} \\ 2 \\ \hline \text{£}125 \ 19 \ 11 \end{array}$	(24)	$\begin{array}{r} \text{£ } s. \text{ d.} \\ 3 \ 19 \ 7\frac{1}{2} \times 42 \\ \hline 27 \ 17 \ 4\frac{1}{2} \\ 6 \\ \hline \text{£}167 \ 4 \ 8 \end{array}$
$\begin{array}{r} \text{£ } s. \text{ d.} \\ 9 \ 11 \ 3\frac{1}{2} \times 28 \\ \hline 66 \ 18 \ 10\frac{3}{4} \\ 4 \\ \hline \text{£}267 \ 15 \ 7 \end{array}$	(25)	$\begin{array}{r} \text{£ } s. \text{ d.} \\ 3 \ 16 \ 7 \times 50 \\ \hline 30 \ 12 \ 8 \\ 7 \\ \hline \text{£}214 \ 8 \ 8 \end{array}$
$\begin{array}{r} \text{£ } s. \text{ d.} \\ 8 \ 6 \ 4 \times 32 \\ \hline 66 \ 10 \ 8 \\ 4 \\ \hline \text{£}266 \ 2 \ 8 \end{array}$	(26)	$\begin{array}{r} \text{£ } s. \text{ d.} \\ 2 \ 3 \ 6 \times 64 \\ \hline 17 \ 8 \ 0 \\ 8 \\ \hline \text{£}139 \ 4 \ 0 \end{array}$

No. ANSWERS.

(27)	£	s.	d.			
	8	4	7	×	81	
			9			
	<hr/>					
	29	1	3			
			9			
	<hr/>					
	£261	11	3			
	<hr/>					

(28)	£	s.	d.			
	0	9	4	×	100	
			10			
	<hr/>					
	4	13	4			
			10			
	<hr/>					
	£46	13	4			
	<hr/>					

(29)	£	s.	d.			
	64	16	7½	by	68	
	£	s.	d.			
	64	16	7½	×	8	
			10			
	<hr/>					
	648	6	3			
			6			
	<hr/>					
	3889	17	6			
	518	13	0			
	<hr/>					
	£4408	10	6			
	<hr/>					

No. ANSWERS.

(30)	£	s.	d.			
	86	13	4½	by		
	£	s.	d.			
	86	13	4½	×		
			10			
	<hr/>					
	866	13	9			
			7			
	<hr/>					
	6066	16	3			
	433	6	10½			
	<hr/>					
	£6500	3	1½			
	<hr/>					

(31)	£	s.	d.			
	69	12	0½	by		
	£	s.	d.			
	69	12	0½	×		
			10			
	<hr/>					
	696	5	5			
			9			
	<hr/>					
	6266	8	9			
	208	17	7½			
	<hr/>					
	£6475	6	4½			
	<hr/>					

N.B.—The Exercises from Nos. 17 to 28 may be performed with factors than those shown in the above examples.

## ANSWERS.

£ s. d.  
648 19 7 $\frac{3}{4}$  by 68

£ s. d.  
648 19 7 $\frac{3}{4}$  × 8  
10

6489 16 5 $\frac{1}{2}$   
6

38988 18 9  
5191 17 2

£44180 15 11

No.

## ANSWERS.

£ s. d.  
658 13 7 by 478

£ s. d.  
658 13 7 × 8  
10

6586 15 10 × 7  
10

65867 18 4  
4

263471 13 4  
46107 10 10  
5269 8 8

£314848 12 10

£ s. d.  
367 16 4 $\frac{1}{4}$  by 246

£ s. d.  
367 16 4 $\frac{1}{4}$  × 6  
10

3678 3 6 $\frac{1}{2}$  × 4  
10

36781 15 5  
2

78568 10 10  
14712 14 2  
2206 18 1 $\frac{1}{2}$

£90488 3 1 $\frac{1}{2}$

(35)

£ s. d.  
467 15 8 $\frac{3}{4}$  by 647

£ s. d.  
467 15 8 $\frac{3}{4}$  × 7  
10

4677 17 9 $\frac{1}{2}$  × 4  
10

46778 12 11  
6

280671 17 6  
18711 9 2  
3274 10 1 $\frac{1}{4}$

£302657 16 9 $\frac{1}{4}$

No.	ANSWERS.		
	£	s.	d.
(36)	675	0	4½ by 608
	£	s.	d.
	675	0	4½ × 8
			10
	6750	8	6½
			10
	67501	15	5
			6
	405010	12	6
	5400	2	10
	£410410	15	4

	£	s.	d.
(37)	568	12	0½ by 785
	£	s.	d.
	568	12	0½ × 5
			10
	5686	0	7½ × 8
			10
	56860	6	3
			7
	394522	3	9
	45088	5	0
	2818	0	3½
	£442428	9	0½

No.	ANSWERS.		
	£	s.	d.
(38)	807	14	6½ by 68
	£	s.	d.
	807	14	6½
			10
	8077	5	2½ ×
			10
	80772	12	1
			6
	484635	12	6
	64618	1	8
	£549253	14	2

	£	s.	d.
(39)	98	13	8½ by 8
	£	s.	d.
	98	13	8½ ×
			10
	986	16	10½
			8
	7894	15	0
	690	15	9½
	£8585	10	9½

ANSWERS.

) £ s. d.  
42 16 7½ by 45

£ s. d.  
42 16 7½ × 5  
10

428 6 3  
4

1713 5 0  
214 3 1½

£1927 8 1½

No.

ANSWERS.

(42) £ s. d.  
820 7 6½ by 268

£ s. d.  
820 7 6½ × 8  
10

8203 15 5 × 6  
10

82037 14 2  
2

164075 8 4  
49222 12 6  
6563 0 4

£219861 1 2

) £ s. d.  
746 0 7½ by 96

£ s. d.  
746 0 7½ × 6  
10

7460 6 0½  
9

67142 14 4½  
4476 3 7½

£71618 18 0

(13)

£ s. d.  
763 16 0½ by 403

£ s. d.  
763 16 0½ × 3  
10

7638 0 7½  
10

76380 6 3  
4

305521 5 0  
2291 8 2½

£307812 13 2½



# SECTION I.

## ANSWERS.

£ s. d.  
278 9 11½ by 784

£ s. d.  
278 9 11½ × 4  
10

2784 19 7 × 8  
10

27849 15 10  
7

194948 10 10  
22279 16 8  
1113 19 10

£218342 7 4

No.

(46)

## ANSWERS.

£ s. d.  
246 16 6 by 1

£ s. d.  
246 16 6 ×  
10

2468 5 0  
2

4936 10 0  
1234 2 6

£6170 12 6

(45)

£ s. d.  
1 7 6 by 365

£ s. d.  
1 7 6 × 5  
10

13 15 0 × 6  
10

137 10 0  
3

412 10 0  
82 10 0  
6 17 6

£501 17 6

(47)

£ s. d.  
1 14 6 by

£ s. d.  
1 14 6 ×  
10

17 5 0  
5

86 5 0  
3 9 0

£89 14 0

ANSWERS.

£ s. d.  
3 10 6 by 568

£ s. d.  
3 10 6 × 8  
10

35 5 0 × 6  
10

352 10 0  
5

1762 10 0  
211 10 0  
28 4 0

£2002 4 0

£ s. d.  
0 12 6 by 365

£ s. d.  
0 12 6 × 5  
10

6 5 0  
10

62 10 0  
3

187 10 0  
37 10 0  
3 2 6

228 2 6  
ns. = 26 5 0

£254 7 6

No.

ANSWERS.

£ s. d.  
1 12 6 by 568

£ s. d.  
1 12 6 × 8  
10

16 5 0 × 6  
10

162 10 0  
5

812 10 0  
97 10 0  
13 0 0

£923 0 0

(51)

£ s. d.  
4 2 6 by  $4\frac{1}{2}$   
4

16 10 0

$\frac{1}{2} = 2 1 3$

£18 11 3

(52)

£ s. d.  
7 16  $7\frac{1}{2}$  by  $7\frac{1}{2}$   
7

54 16  $4\frac{1}{2}$

$\frac{1}{2} = 3 18 3\frac{1}{2}$

$\frac{1}{4} = 1 19 1\frac{3}{4} - \frac{2}{4}$

£60 13 10 -  $\frac{2}{4}$

No.      ANSWERS.

(53)      £   s.   d.  
           28 19 8½ by 9½  
                     9

$$\frac{1}{4} = \begin{array}{r} 260 \ 17 \ 6\frac{1}{2} \\ 7 \ 4 \ 11 \end{array} - \frac{1}{4}$$

$$\underline{\underline{£267 \ 2 \ 5\frac{1}{2} - \frac{1}{4}}}$$

(54)      £   s.   d.  
           87 13 9½ by 12½  
                     12

$$\frac{1}{2} = \begin{array}{r} 1052 \ 5 \ 6 \\ 43 \ 16 \ 10\frac{1}{2} \end{array}$$

$$\underline{\underline{£1096 \ 2 \ 4\frac{1}{2}}}$$

(55)      £   s.   d.  
           874 12 10½ by 10½  
                     10

$$\begin{array}{l} \frac{1}{2} = \begin{array}{r} 8746 \ 8 \ 11\frac{1}{2} \\ 487 \ 6 \ 5\frac{1}{2} \end{array} \\ \frac{1}{4} = \begin{array}{r} 218 \ 13 \ 2\frac{1}{2} \end{array} - \frac{1}{4} \end{array}$$

$$\underline{\underline{£9402 \ 8 \ 7\frac{1}{2} - \frac{1}{4}}}$$

(56)      £   s.   d.  
           478 14 6½ by 11½  
                     11

$$\frac{1}{2} = \begin{array}{r} 5265 \ 19 \ 11\frac{1}{2} \\ 239 \ 7 \ 3\frac{1}{2} \end{array}$$

$$\underline{\underline{£5505 \ 7 \ 2\frac{1}{2}}}$$

No.      ANSWERS.

(57)      £   s.   d.  
           7 8 9½ by  
                     7

$$\frac{1}{2} = \begin{array}{r} 52 \ 1 \ 6\frac{1}{2} \\ 1 \ 17 \ 2\frac{1}{2} \end{array} -$$

$$\underline{\underline{£53 \ 18 \ 8\frac{1}{2} -}}$$

(58)      £   s.   d.  
           4 19 8½ by  
                     9

$$\frac{1}{2} = \begin{array}{r} 44 \ 17 \ 4\frac{1}{2} \\ 2 \ 9 \ 10\frac{1}{2} \end{array}$$

$$\underline{\underline{£47 \ 7 \ 2\frac{1}{2}}}$$

(59)      £   s.   d.  
           48 17 6½ by  
                     10

$$\begin{array}{r} 488 \ 15 \ 5 \\ 4 \end{array}$$

$$\frac{1}{2} = \begin{array}{r} 1955 \ 1 \ 8 \\ 342 \ 2 \ 9\frac{1}{2} \\ 24 \ 8 \ 9\frac{1}{2} \end{array}$$

$$\underline{\underline{£2321 \ 13 \ 2\frac{1}{2}}}$$

ANSWERS.

£ s. d.  
59 14 7½ by 87½

£ s. d.  
59 14 7½ × 7  
10

597 6 0½  
8

4778 8 4  
418 2 2½

½ = 11 18 11 - ½

£5208 9 5½ - ½

£ s. d.  
796 13 4½ by 49½

£ s. d.  
796 13 4½ × 9  
10

7966 13 9  
4

31866 15 0  
7170 0 4½

⅔ = 227 12 4½ - ⅔

£39264 7 9 - ⅔

£ s. d.  
7)796 13 4½

113 16 2½ - ⅔  
2

£227 12 4½ - ⅔

No.

ANSWER.

(62) £ s. d.  
864 16 0½ by 94 ⅔

£ s. d.  
864 16 0½ × 4  
10

8648 0 2½  
9

77832 1 10½  
3459 4 1

⅔ = 345 18 4½ - ⅔

£81637 4 4½ - ⅔

£ s. d.  
5)864 16 0½

172 19 2½ - ⅔  
2

£345 18 4½ - ⅔

## COMPOUND DIVISION.

No.	ANSWERS.		
	£	s.	d.
1.	34	8	10 $\frac{3}{4}$
2.	14	4	1
3.	17	9	7 $\frac{3}{4}$
4.	149	15	0
5.	29	9	11 $\frac{3}{4}$
6.	58	4	10 $\frac{1}{2}$
7.	1080	19	8 $\frac{3}{4}$
8.	834	5	11 $\frac{1}{4}$
9.	506	0	0 $\frac{1}{2}$
10.	789	16	3 $\frac{1}{4}$
11.	392	12	7 $\frac{1}{2}$
12.	14	2	1
13.	7	11	0
14.	72	0	1 $\frac{1}{2}$
15.	97	19	1 $\frac{3}{4}$

(16)	£	s.	d.
24 {	4)24	17	6
	6)6	4	4 $\frac{1}{2}$
	£1	0	8 $\frac{3}{4}$

(17)	£	s.	d.
36 {	6)576	18	3
	6)96	2	2 $\frac{1}{2}$
	£16	0	4 $\frac{1}{4}$ — $\frac{3}{8}$

(18)	£	s.	d.
48 {	8)447	12	2
	6)155	19	0 $\frac{1}{4}$
	£9	6	6

No.	ANSWERS.		
(19)	£	s.	d.
56 {	8)547	12	4
	7)68	9	0 $\frac{1}{2}$
	£9	15	6 $\frac{3}{4}$ —

(20)	£	s.	d.
49 {	7)740	13	4
	7)105	16	2 $\frac{1}{4}$ —
	£15	2	8 $\frac{1}{2}$ —

(21)	£	s.	d.
72 {	9)223	17	6
	8)24	17	6
	£3	2	2 $\frac{1}{4}$

(22)	£	s.	d.
28 {	7)92	8	11 $\frac{1}{2}$
	4)13	4	1 $\frac{1}{2}$ —4
	£3	6	0 $\frac{1}{4}$ — $\frac{11}{16}$

(23)	£	s.	d.
27 {	3)278	18	3 $\frac{1}{2}$
	9)92	19	5 $\frac{1}{4}$
	£10	6	7 $\frac{1}{4}$

## ANSWERS.

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 4) 7 \quad 11 \quad 2\frac{1}{2} \end{array}$$

$$8) 1 \quad 17 \quad 4\frac{1}{2} - 2$$

$$\begin{array}{r} 4 \quad 8\frac{1}{2} - \frac{26}{3\frac{1}{2}} \\ \hline \end{array}$$

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 11) 174 \quad 8 \quad 0 \end{array}$$

$$6) 15 \quad 17 \quad 1 - 4$$

$$\begin{array}{r} \text{£} 2 \quad 12 \quad 10 - \frac{48}{68} \\ \hline \end{array}$$

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 9) 246 \quad 3 \quad 11\frac{1}{2} \end{array}$$

$$9) 27 \quad 7 \quad 1\frac{1}{4} - 1$$

$$\begin{array}{r} \text{£} 3 \quad 0 \quad 9\frac{1}{4} - \frac{73}{81} \\ \hline \end{array}$$

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 12) 129 \quad 7 \quad 9 \end{array}$$

$$11) 10 \quad 15 \quad 7\frac{3}{4}$$

$$\begin{array}{r} 19 \quad 7\frac{1}{4} \\ \hline \end{array}$$

## No. ANSWER.

$$(28) \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \quad \text{£} \quad \text{s.} \quad \text{d.} \\ 37) 470 \quad 16 \quad 4\frac{1}{2} (12 \quad 14 \quad 5\frac{3}{4} \end{array}$$

$$37$$

$$100$$

$$74$$

$$26$$

$$20$$

$$536$$

$$37$$

$$166$$

$$148$$

$$18$$

$$12$$

$$220$$

$$185$$

$$35$$

$$4$$

$$143$$

$$111$$

81 rem.

The Exercises from No. 16 to 27 may be worked with other factors here shown.

No.	ANSWER.						No.	ANSWER.					
(29)	£	s.	d.	£	s.	d.	(30)	£	s.	d.	£	s.	d.
146)	487	19	7 $\frac{3}{4}$	(3	6	10	365)	798	17	0 $\frac{1}{2}$	(2	3	9
	438							730					
	<u>49</u>							<u>68</u>					
	20							20					
	<u>999</u>							<u>1377</u>					
	876							1095					
	<u>123</u>							<u>282</u>					
	12							12					
	<u>1483</u>							<u>3384</u>					
	1460							3285					
	<u>23</u>							<u>99</u>					
	4							4					
	<u>95</u>							<u>398</u>					
								365					
								<u>39</u>					

No.	ANSWER.					
(31)	£	s.	d.	£	s.	d.
478)	980	7	6 $\frac{1}{4}$	(2	1	0
	956					
	<u>24</u>					
	20					
	<u>487</u>					
	478					
	<u>9</u>					
	12					
	<u>114</u>					
	4					
	<u>457</u>					





No.	ANSWER.						No.	ANSWER.					
(34)	£	s.	d.	£	s.	d.	(35)	£	s.	d.	£	s.	d.
718)	43	17	16	8 $\frac{3}{4}$	(6	0	3 $\frac{1}{4}$	76)	97	13	6 $\frac{1}{4}$	(1	5
	4308								76				
	<u>9</u>								<u>21</u>				
	20								20				
	<u>196</u>								<u>433</u>				
	12								380				
	<u>2360</u>								<u>53</u>				
	2154								12				
	<u>206</u>								<u>642</u>				
	4								608				
	<u>827</u>								<u>34</u>				
	718								4				
	<u>109</u>								<u>138</u>				
	<u><u>109</u></u>								<u>76</u>				
									<u>62</u>				

No.	ANSWER.					
	£	s.	d.	£	s.	d.
6)	647	14	7 $\frac{3}{4}$	(3	6	1
196)	588					
	<u>59</u>					
	20					
	<u>1194</u>					
	1176					
	<u>18</u>					
	12					
	<u>228</u>					
	196					
	<u>27</u>					
	4					
	<u>111</u>					

No.	ANSWER.					
	£	s.	d.	£	s.	d.
(37)	870	0	6 $\frac{1}{2}$	(3	5	10 $\frac{3}{4}$
264)	792					
	<u>78</u>					
	20					
	<u>1560</u>					
	1320					
	<u>240</u>					
	12					
	<u>2886</u>					
	2640					
	<u>246</u>					
	4					
	<u>986</u>					
	792					
	<u>194</u>					

No.	Answers.					
(38)	£	s.	d.	£	s.	d.
489)998	19		7½	2	0	7½
	978					
	15					
	20					
	819					
	12					
	3835					
	8423					
	412					
	4					
	1651					
	1467					
	164					
(39)	£	s.	d.	£	s.	d.
785)7086	8		0½	6	7	6½
	7065					
	21					
	20					
	428					
	12					
	5136					
	4710					
	426					
	4					
	1706					
	1570					
	136					

No. Answers.

(40)

	£	s.	d.
3½)	42	14	6½
2			2
<hr/>			
7	85	9	1
<hr/>			
	£12	4	1¾-¾
<hr/>			

(41)

	£	s.	d.
6¼)	64	17	7¼
4			4
<hr/>			
25 {	5)	259	10 5
	5)	51	18 1
	£10	7	7¼-3
<hr/>			

o.	ANSWER.			
	£	s.	d.	
2)	97	18	8 $\frac{1}{2}$	
	4		4	
<hr/>				
31)	891	14	11	(12 12 8 $\frac{1}{2}$
	372			
<hr/>				
	19			
	20			
<hr/>				
	394			
	372			
<hr/>				
	22			
	12			
<hr/>				
	275			
	248			
<hr/>				
	27			
	4			
<hr/>				
	108			
	93			
<hr/>				
	15			
<hr/>				

No.	ANSWER.			
	£	s.	d.	
(43)	847	12	5 $\frac{1}{2}$	
47 $\frac{1}{2}$ )	2		2	
<hr/>				
95)	1695	4	11	(17 16 10 $\frac{1}{2}$
	95			
<hr/>				
	745			
	665			
<hr/>				
	80			
	20			
<hr/>				
	1604			
	950			
<hr/>				
	654			
	570			
<hr/>				
	84			
	12			
<hr/>				
	1019			
	950			
<hr/>				
	69			
	4			
<hr/>				
	276			
	190			
<hr/>				
	86			
<hr/>				

No. ANSWER.

(44) £ s. d.

76½) 948 17 6½

4 4

— £ s. d.

307) 3795 10 3(12 7 8

307

725

614

111

20

2230

2149

81

12

975

921

54

No. ANSWER.

(45) £ s. d.

43½) 408 0 10½

5 5

— £ s.

217) 2040 4 4½(9 8

1958

87

20

1744

1736

8

12

100

4

402

217

185

No.	ANSWER.					
	£	s.	d.			
46)	64	17	6½			
4			4			
—						
19)	259	10	2	(13	13	2
	19					
—						
	69					
	57					
—						
	12					
	20					
—						
	250					
	19					
—						
	60					
	57					
—						
	3					
	12					
—						
	38					
	38					
—						

No.	ANSWER.					
	£	s.	d.			
(47)	87	14	2½			
9½)			2			
2			2			
—						
19)	175	8	5½	(9	4	7½
	171					
—						
	4					
	20					
—						
	88					
	76					
—						
	12					
	12					
—						
	149					
	133					
—						
	16					
	4					
—						
	66					
	57					
—						
	9					
—						

No.	ANSWER.					
	£	s.	d.			
(48)	38	12	5½			
8½)			5			
5			5			
—						
6)	193	2	2½			
—						
7)	32	3	8½—3			
—						
42	£4	11	11½—½			
—						

No. ANSWER.

(49) £ s. d.

78 $\frac{1}{5}$ ) 789 0 6 $\frac{1}{5}$ 

5 5

— £ s. d.

391 ) 3045 2 9 $\frac{1}{2}$  (10 1 9 $\frac{1}{2}$ 

3910

85

20

702

391

811

12

3741

8519

222

4

891

782

109

No. ANSWER.

(50) £ s. d.

84 $\frac{1}{3}$ ) 807 16 10 $\frac{1}{3}$ 

3 3

— £

254 ) 2423 10 6 $\frac{1}{2}$  (9 1

2286

137

20

2750

2540

210

12

2526

2286

240

4

963

762

201

ANSWERS.						
)	£	s.	d.			
3)	978	17	6½			
			7			
-	_____	_____	_____	£	s.	d.
4)	8852	2	11½	(10	3	3½
	674					
	_____					
	112					
	20					
	_____					
	2242					
	2022					
	_____					
	220					
	12					
	_____					
	2651					
	2022					
	_____					
	629					
	4					
	_____					
	2517					
	2022					
	_____					
	495					
	_____					
2)						
£	s.	d.	£	s.	d.	
64	14	7)	764	16	9	
20			20			
_____			_____			
294			15296			
12			12			
_____			_____			
35			183561(2	8491		
_____			175070	87535		
			_____			
			8491			
			_____			

No.	ANSWERS.					
(53)	£	s.	d.	£	s.	d.
	249	17	8½	(987	13	8½
	20			20		
	_____			_____		
	4997			19758		
	12			12		
	_____			_____		
	59972			237044		
	4			4		
	_____			_____		
	239891			)948177(¾d.		
	_____			719678		
				_____		
				223504		
				_____		
(54)	£	s.	d.	£	s.	d.
	24	19	7½	(847	10	0½
	20			20		
	_____			_____		
	499			16950		
	12			12		
	_____			_____		
	5995			203400		
	4			4		
	_____			_____		
	23983			f. d.		
	_____			813601(33=8½		
				71949		
				_____		
				94111		
				71949		
				_____		
				22162		
				_____		



No. ANSWER.

(55)

£	s.	d.	£	s.	d.
120	16	0½	210	3	4½
20			20		
2416			4203		
12			12		
28992			50440		
4			4		
115971			201762( $\frac{1}{4}$ )		
			115941		
			85791		

No. ANSWER.

(56)

£	s.	d.	£	s.	d.
710	10	4½	901	12	10½
20			20		
14210			18032		
12			12		
170524			216394		
4			4		
682097			865579( $\frac{1}{4}$ )		
			662097		
			183482		

No. ANSWER.

(57)

£	s.	d.	£	s.	d.
637	14	7)	7826	13	3½
20			20		
12754			156533		
12			12		
153055			1878399		
4			4		
612220			7513597(12=3)		
			612220		
			1391397		
			1224440		
			166957		

ANSWERS.

$$\begin{array}{r}
 56 \left\{ \begin{array}{l} 8 \overline{) 4768} \\ 7 \overline{) 596} \end{array} \right. \\
 \hline
 85 - \frac{1}{4} \\
 \hline
 \hline
 \\
 \\
 2 \left\{ \begin{array}{l} 4 \overline{) 800000000} \\ 8 \overline{) 200000000} \end{array} \right. \\
 \hline
 25000000 \\
 \hline
 \hline
 \end{array}$$

No.      ANSWER.

$$\begin{array}{r}
 (60) \quad 8765 \overline{) 250000000} (2852 \\
 17530 \\
 \hline
 74700 \\
 70120 \\
 \hline
 45800 \\
 43825 \\
 \hline
 19750 \\
 17530 \\
 \hline
 2220 \\
 \hline
 \hline
 \end{array}$$



## REDUCTION.

No.	ANSWERS.	No.	ANSWERS.
1.	93312 farthings.	18.	6136 quarts.
2.	6960 shillings.	19.	23328 pence.
3.	9240 pence.	20.	348 <i>l</i> .
4.	14076 pence.	21.	2 <i>l</i> . 0 <i>s</i> . 8 <i>d</i> .
5.	56304 farthings.	22.	15 <i>l</i> . 19 <i>s</i> . 9½ <i>d</i> .
6.	57291 farthings.	23.	272 ounces or 17 <i>lbs</i> .
7.	1864 pounds.	24.	16 cwt. 2 qrs. 16 <i>lbs</i> .
8.	1668 pounds.	25.	14 cwt. 3 qrs. 16 <i>lbs</i> .
9.	19984 grains.	26.	20 pounds.
10.	45974 grains.	27.	6720 pounds.
11.	175200 hours.	28.	327 hhds. 57 galls.
12.	5280 feet.	29.	365 days.
13.	16380 gallons.	30.	273 miles.
14.	24208376 minutes.	31.	28 ells 4 qrs.
15.	226633 yards.	32.	969 feet 242 inches.
16.	490880 square acres.	33.	575 yards 1 qr.
17.	1825376 cubic inches.		

## PROMISCUOUS EXERCISES.

No.	ANSWERS.
1.	Ninepence halfpenny a pound.
2.	118 <i>l</i> . 16 <i>s</i> . 6 <i>d</i> .
3.	59 pairs.
4.	193 <i>l</i> . 5 <i>s</i> . 9 <i>d</i> .
5.	117 tons 17 cwt. 2 qrs.
6.	14 cwt. 1 qr.
7.	6 <i>l</i> . 10 <i>s</i> . 6 <i>d</i> .
8.	97 <i>l</i> . 16 <i>s</i> . 3 <i>d</i> .
9.	277 tons 6 cwt. 2 qrs. 8 oz.
10.	23456 and 28682 ounces.
11.	109 tons 10 cwt.
12.	106 and 2859 twopences.
13.	141 <i>l</i> . 12 <i>s</i> . 10¾ <i>d</i> .
14.	14 <i>l</i> . 18 <i>s</i> . 11 <i>d</i> .
15.	78 <i>l</i> . 8 <i>s</i> . 1½ <i>d</i> .
16.	185 and 545 inches.
17.	A halfpenny.

No.

ANSWERS.

18. 630 and 153 sixpences.

19. Half the required No.  $\times$  12 oz. + ditto  $\times$  10 oz. = ditto  $\times$  22 oz. = the required No.  $\times$  11 oz. Therefore  $2387 \times 16$ , or 38192 oz.  $\div$  11 oz. gives 3472 packages.

20. March 20th, p.m., to Dec. 14th, 12 p.m.

	269 days =	23241600 ticks
Dec. 15th, 12 a.m., to 11 a.m., 11 hours =		99600 "
to 11—21	21 min. =	1260 "

---

 23282460 times
 

---

21. A sovereign = 20s. }  
      $\frac{1}{2}$  do. = 10s. } 460l. 16s. = 9216 shil.  
     A crown = 5s. }  $38 \div 9216 = 256$  of each sort.  
     A shilling = 1s. }

22. 35 quires at 8d. = 280 pence, which at 10d. a quire will buy  $280 \div 10$  or 28 quires.

23. 1400 land miles each 1760 yards = 2464000 yards, which is reduced by division to knots of 2000 yards each. 1400 land miles = 1231 nautical miles.

24. The gain is 1 minute 38 seconds = 98 seconds in 14 days, or 7 seconds in 1 day.

25. 9 bushels at 42d. = 378d. worth of cherries at 8d. a lb.; hence  $378 \div 8 = 47$  lb. 4 oz.

26. Saves 3s. 6d. a fortnight or 1s. 9d. a week, which in 1 guinea is contained 12 times, in 50 guineas is contained  $12 \times 50 = 600$  weeks, or 11 years 28 weeks.

27. 10 chairs at 19s. 6d. + 2 at 27s. = 12l. 9s. to be deducted from 16l. 5s. 6d., leaves 3l. 15s. 6d.

28.  $9909 + 12000 + 1212 + 15000 + 1515 = 39636$ l.

29. 6 cwt. of sugar at 38s. =	£11 8 0
24 yards of cloth at 8s. 3 $\frac{1}{2}$ d. =	9 19 6

---

Cash to be given with cloth	£ 1 8 6
-----------------------------	---------

---

30. 5 yards at 4 $\frac{1}{2}$ d. + 11 yards at 3s. 6d. = 2l. 0s. 4 $\frac{1}{2}$ d.  $2l. 0s. 4\frac{1}{2}d. \div 4s. 9d. = 8\frac{1}{2}$  yards.

31.  $106l. 4s. \div 32 = 3l. 6s. 4\frac{1}{2}d.$  per piece which  $\div 2s. 5\frac{1}{2}d. = 27$  yards.

No.

ANSWERS.

32. 450 feet of wood offered for 126 galls., 450 feet at 2s. 11d. = 65*l.* 12s. 6d., the 126th part of which is 10s. 5d. the price per gall.

33.  $32s. 6d. \times 26 = 845$  }  
 $43s. 0d. \times 23 = 989$  } + = 1834s. 1834s.  $\div$  14s.  
 = 131 gallons.

34. Of 78 glasses he earns 8 at  $7\frac{1}{2}d. = 5s. + 65$  at  $14\frac{1}{2}d. = 4*l.* 3s. 6\frac{1}{2}d.$ , from which deduct 5 at 4d. = 1s. 8d., leaves 4*l.* 1s.  $10\frac{1}{2}d.$  the answer.

35. 7 days' wages at 5s. + 2 days' loss of income at 4s. 6d. = 44s.: but 5 days' wages at 7s. 6d. = 37s. 6d.—is 6s. 6d. cheaper.

## SECTION 2.

## SIMPLE PROPORTION.

No.

ANSWERS.

1. 3 : 6 :: 12 : 24.
2. 6 : 8 :: 3 : 4.
3. 3 : 6 :: 8 : 16.
4. 6 : 12 :: 4 : 8.
5. 10 : 150 :: 68 : 1020.
6. 1020 : 68 :: 150 : 10.
7. 150 : 10 :: 1020 : 68.
8. 68 : 1020 :: 10 : 150.
9. 2 tons : 17 tons :: 25*l.* : 212*l.* 10s.
10. 10 lbs. : 150 lbs. :: 5s. : 3*l.* 15s.
11. 9 yds. : 36 yds. :: 18s. : 3*l.* 12s.
12. 5 lbs. : 1 lb. :: 15s. : 3s.
13. 4 yds. : 18 yds. :: 2s. : 9s.
14. 1 cwt. : 215 cwt. :: 50s. : 537*l.* 10s.
15. 5 tons : 50 tons :: 27*l.* : 270*l.*
16. 2 qrs. : 240 yds. :: 12s. : 288*l.*
17. 5s. : 80*l.* :: 1 yd. : 320 yds.
18. 5 cwt : 6000 lbs. :: 8s. : 4*l.* 5s., 400 remains.

No.

ANSWERS.

19. 5s. 6d. : 140s. :: 2 yds. : 50 yds., 60 remains.  
 20. 3s. 4d. : 1l. 10s. :: 1 yd. : 9 yds.  
 21. 2 tons : 14 tons :: 28l. 10s. : 199l. 10s.  
 22. 5 brls. : 100 brls. :: 18s. 6d. : 18l. 10s.  
 23. 4 lbs. : 112 lbs. :: 5½d. : 12s. 8d.  
 24. 1 cwt. : 215 cwt. :: 50s. : ?  $215 \times 50 = 10750s.$ , or  
 573l. 10s.  
 25. 3 yds. : 2 yds. :: 30 yds. : ?  $30 \times 2 \div 3 = 20$  yds.  
 26. 1 bar. : 130 bar. :: 10s. : ?  $130 \times 10 \div 20 = 65l.$   
 27. 12 cwt. — 2 cwt. = 10 cwt. are to be carried.  
 10 : 12 :: 70 miles :  $\times 12 = 840 \div 10 = 84$  miles.  
 28. 1 cwt. : 150 cwt. :: 3l. : ?  $150 \times 3 = 450l.$   
 29. 12 mo. : 7 mo. :: 400l. : ?  $400 \times 7 \div 12 = 233l. 6s. 8d.$   
 30. 1 day : 70 days :: 30 miles : ?  $30 \times 70 = 2100$  miles.  
 31. 1 week : 52 weeks :: 4l. : ?  $52 \times 4 = 208l.$   
 32. 8 mo. : 3 mo. :: 4000 sol. : ?  $4000 \times 3 \div 8 = 1500.$

4000

1500

---

 2500 number to be sent away.

33. 15 hours : 13 hours :: 8 days : ?  $13 \times 8 \div 15 = 6\frac{1}{3}$  days.  
 34. 1 gal. : 256 gals. :: 12s. : ?  $256 \times 12 = 3072s.$ , or  
 153l. 12s.  
 35. 8 days : 28 days :: 136 masons : ?  $136 \times 28 \div 8 = 476$  masons.  
 36. 30 days : 365 days :: 100l. : ?  $365 \times 100 = 36500 \div 30 = 1216l. 13s. 4d.$   
 37. 20 cwt. : 15 cwt. :: 30 days : ?  $13 \times 30 \div 20 = 22\frac{1}{2}$  days.  
 38. 150l. : 400l. :: 12 ms. : ?  $400 \times 12 \div 150 = 32$  mo.  
 39. 12 horses : 8 horses :: 2 mo. : ?  $8 \times 2 \div 12 = 1\frac{1}{3}$  mo.  
 40. 16 oz. : 14 oz. :: 120 lbs. : ?  $120 \times 14 \div 16 = 105$  lbs.  
 41. 1 oz. : 16 lbs. :: 4s. : ?  $16 \text{ lbs.} = 256 \text{ ozs.}$   $256 \times 4 \div 20 = 51l. 4s.$   
 42. 1 ton : 17 tons ; : 5l. : ?  $17 \text{ ton} = 340 \text{ cwt.}$   $340 \text{ cwt.} \times 5 = 1700l.$   
 43. 1 oz. : 224 lbs. 6 ozs. :: 3s. : ?  $224 \text{ lbs. } 6 \text{ oz.} = 3590 \text{ ounces.}$   $3590 \times 3 \div 20 = 538l. 10s.$

No.

ANSWERS.

44. 1 lb. : 156 cwt. 2 qrs. : : 7d. : ? 156 cwt. 2 qrs. = 528 lbs.  $17528 \times 7 = 122696$  pence, or 511l. 4s. 8d.

45. 1 yd. : 110 yds. 2 qrs. 3 nls. : : 25s. : ?

yd. = 16 nails }  $1771 \times 25 \div 16 = 2767s. 2\frac{1}{4}d.$

0 yds., &c. = 1771 nails }  $2767s. 2\frac{1}{4}d. = 138l. 7s. 2\frac{1}{4}d.$

46. 1 cwt. : 17 cwt. 2 qrs. 7 lbs. : : 126s. : ?

cwt. = 112 lbs. }  $1967 \times 126 \div 112 = 2212s. 10\frac{1}{2}d.$

cwt., &c. = 1967 lbs. }  $2212s. 10\frac{1}{2}d. = 110l. 12s. 10\frac{1}{2}d.$

47. 32s. : 760l. 12s. : : 1 cwt. : ? 760l. 12s. = 15212s.

$212 \div 32 = 475$  cwt. 1 qr. 14 lbs.

48. 12 lbs. 6 oz. 4 dwts. : 3 lbs. 1 oz. 11 dwts. : : 150l. : ?

lbs. 6 ozs. 4 dwts. = 3004 dwts. }  $751 \times 150 = 112650.$

3s. 1 oz. 11 dwts. = 751 dwts. }  $650 \div 3004 = 37l. 10s.$

49. 1 cwt. : 120 cwt. : : 18s. 6d. : ? 18s. 6d. = 222d.  $\times$

= 26640d. or 111l.

50. 1 lb. : 112 lbs. : : 3 $\frac{1}{4}$ d. : ?  $3\frac{1}{4}d. = 13f. \times 112 = 1456f.$

l. 10s. 4d.

51. 1 acre : 120 acres : : 14s. 6d. : ? 14s. 6d. = 174d.  $\times$

= 20880d., or 87l.

52. 1 piece : 324 pieces : : 2s. 8 $\frac{1}{2}$ d. : ? 2s. 8 $\frac{1}{2}$ d. = 65 half-

pence  $65 \times 324 = 21060$  halfpence, or 43l. 17s. 6d.

53. 1 yd. : 132 yds. : : 16s. 4d. : ? 16s. 4d. = 196d.  $\times$  132

= 25872, or 107l. 16s.

54. 1 oz. : 18 lbs. 10 ozs. : : 3s. 4d. : ?

4d. = 40 pence }  $298 \times 40 = 11920$  pence, or

lbs. 10 ozs. = 298 ozs. } 49l. 13s. 4d.

55. 1 lb. : 2 cwt. 3 qrs. : : 6s. 8d. : ?

wt. 3 qrs. = 308 lbs. }  $308 \times 80 = 24640d.$  or

8d. = 80d. } 102l. 13s. 4d.

56. 1 yd. : 76 yds. 3 qrs. : : 15s. 6d. : ?

6d. = 186d.

yds. 3 qrs. = 307 qrs. }  $186 \times 307 \div 4 = 14275\frac{1}{2}d.,$  or

l. = 4 qrs. } 59l. 9s. 7 $\frac{1}{2}$ d.

57. 1 cwt. : 12 cwt. 2 qrs. : : 14s. 4d. : ?

4d. = 172d.

wt. 2 qrs. = 50 qrs. }  $172 \times 50 \div 4 = 2150d.,$  or

l. = 4 qrs. } 8l. 19s. 2d.



No.

ANSWERS.

58. 1 cwt. : 17 cwt. 2 qrs. 7 lbs. :: 6*l*. 6*s*. : ?6*l*. 6*s*. = 126*s*.

17 cwt. 2 qrs. 7 lbs. = 1967 lbs.

1 cwt. = 112 lbs.

$$\left. \begin{array}{l} 1967 \times 126 \div 112 \\ 2212*s*. 10\frac{1}{2}*d*., or 110*l*. \\ 10\frac{1}{2}*d*. \end{array} \right\}$$

59. 1*l*. 7*s*. 6*d*. : 1*l*. 13*s*. 6*d*. :: 3 lbs. 6 ozs. : ?

3 lbs. 6 ozs. = 54 ozs.

1*l*. 13*s*. 6*d*. = 402*d*.1*l*. 7*s*. 6*d*. = 330*d*.

$$\left. \begin{array}{l} 402 \times 54 \div 330 = 65\frac{4}{5} \text{ ozs.} \\ 4 \text{ lbs. } 1\frac{4}{5} \text{ oz.} \end{array} \right\}$$

60. 1 lb. :  $\frac{1}{2}$  oz. :: 10*s*. 8*d*. : ?10*s* 8*d*. = 128*d*. $\frac{1}{2}$  oz. = 1 half-ounce

1 lb. = 32 half-ounces

$$\left. \begin{array}{l} 128 \div 32 = 4*d*. \end{array} \right\}$$

61.	£	s.	d.		£	s.	d.
	0	5	5 $\frac{1}{2}$	$\times 480 =$	131	0	0 cost of oil
		4	0	$\times 4 =$	0	16	0 freight
		0	6	$\times 480 =$	12	0	0 duty
		1	0	$\times 4 =$	0	4	0 portorage

---

 Entire cost £144 0 0
 

---

480 gals. : 1 gal. :: 144*l*. : ?

$$144 \times 20 \div 480 = 6*s*. \text{ per gallon.}$$

62. 1 gal. at 5*s*., 1 gal. at 6*s*., and 1 gal. at 7*s*. = 18*s*.3 gals. : 1 gal. :: 18*s*. : ?  $18 \div 3 = 6*s*. \text{ a gal}$ 63. 1 qt. at 3 $\frac{1}{2}$ *d*., 1 qt. at 4*d*., and 1 qt. at 4 $\frac{1}{2}$ *d*. = 12*d*.3 qts. : 1 qt. :: 12*d*. : ?  $12 \div 3 = 4*d*. \text{ a qu}$ 64. 100 brls. at 14*s*. = 70*l*.100 „ 16*s*. = 80*l*.100 „ 17*s*. = 85*l*.100 „ 19*s*. = 95*l*.

$$\left. \begin{array}{l} \\ \\ \\ \end{array} \right\} = 330*l*.$$

---

 400

---

 400 brls. : 1 brl. :: 330*l*. : ?

$$330 \times 20 \div 400 = 16*s*. 6*d*. \text{ a ba}$$

65. 1 ream at 9*s*. 9*d*. and 1 ream at 12*s*. 3*d*. = 22*s*.
 22*s*. : 55*l*. :: 2 reams : ?  $55 \times 20 \times 2 \div 22 = 100 \text{ ream}$   
 all  $\div 2 = 50$  reams of each kind.

No.

ANSWERS.

66. 1 brl. at 14s., 1 brl. at 16s., and 1 brl. at 19s. = 49s.  
 49 brls. : 490l. :: 3 brls. : ?  $490 \times 20 \times 3 \div 49 = 600$   
 barrels in all  $\div 3 = 200$  of each kind.

67. 100l. : 1450l. :: 1l. : ?  $1450 \div 10 = 14l. 10s.$

	£	s.
From 1450	0	the price
Take 14	10	the discount

£1435 10 difference to pay

68. 4 lbs.  $\times 200 = 800$  lbs. consumed weekly.  
 800 lbs. : 24000 lbs. :: 1 week : ?  $24000 \div 800 = 30$  weeks.

69. 12 ozs.  $\times 3 \times 25 = 900$  ozs. consumed weekly.  
 900 ozs. : 3150 lbs. :: 1 week : ?  $3150 \times 16 \div 900 = 56$   
 weeks.

70. 10 lbs.  $\times 700 = 7000$  lbs. consumed weekly.  
 7000 lbs. : 184000 lbs. :: 1 week : ?  $184000 \div 7000 =$   
 26 weeks 2 days.

71. 327 pages : 400 pages :: 156 pages : ?  $156 \times 400 \div$   
 $327 = 191$ st page.

72. 1 piece of 4 lbs., 1 of 3 lbs., 1 of 2 lbs., 1 of 1 lb.,  
 and 1 of  $\frac{1}{2}$  lb. =  $10\frac{1}{2}$  lbs.  $10\frac{1}{2}$  lbs. : 100 cwt. 2 qrs. 14 lbs.  
 :: 1 piece : ?

$10\frac{1}{2}$  lbs. = 21 half-pounds

100 cwt. 2 qrs. 14 lbs. = 22540 half-pounds.

$22540 \div 21 = 1073$  pieces of each kind and  $3\frac{1}{2}$  lbs. left.

73. 100l. : 35l. :: 10l. : ?  $35 \times 10 \div 100 = 3l. 10s.$

Cost	£35 0
Profit	3 10

Selling price £38 10

74. 15 tons : 1 ton :: 37l. 10s. : ?  $37l. 10s. \div 15 =$   
 2l. 10s. the gain per ton.

	£	s.
Cost per ton	37	10
Gain per ton	2	10
Selling price	<u>£40</u>	<u>0</u>

No.

ANSWERS.

75.  $45 - 16 = 29$ .  $4 : 3 :: 21s. : ?$   $21 \times 3 \div 4 = 63$ ,  
or  $15s. 9d.$

$21s. 0d. \times 29 = 609s.$  the price of 29 barrels

$15s. 9d. \times 16 = 252s.$  the price of 16 barrels

---

20 ) 861

---

£43 1 the price of all.

76.  $840 \text{ eggs} \div 10 = 84d.$  price of 840 eggs

240 „  $\div 8 = 30d.$  „ 240 „

---

114d. 1080

$18d. : 1080 :: 2d. : ?$   $1080 \times 2 \div 18 = 120d.$

120d. the selling price

114d. the cost price

---

6d. is the gain.

77. 1 lb. troy = 5760 grains }

1 lb. avoirdup. = 7000 grains }

$5760 \text{ grs.} : 7000 \text{ grs.} :: 66s. : ?$   $7000 \times 66 \div 5760 =$   
 $4l. 0s. 2\frac{1}{2}d.$

78.  $48 \text{ days} : 68 \text{ days} :: 12 \text{ miles} : ?$   $68 \times 12 \div 48 =$   
17 miles.

79. 1 lb. troy = 5760 grs. }

1 lb. avoird. = 7000 grs. }

$7000 \text{ grs.} : 5760 \text{ grs.} ::$

$4l. 0s. 2\frac{1}{2}d. : ?$   $4l. 0s. 2\frac{1}{2}d. = 1925 \text{ halfpence} \times 5760 \div$   
 $7000 = 3l. 6s.$

80.  $5 \text{ cub. ft.} \times 17493 \times 1000 = 87465000$ , the gas con-  
sumed by the street lamps

$4 \text{ cub. ft.} \times 192724 \times 1000 = 770896000$ , the gas con-  
sumed by the argand burners.

---

858361000, the entire

quantity consumed.

$9000 \text{ cub. ft.} : 858361000 \text{ cub. ft.} :: 1 \text{ ton} : ?$   $9000 \div$   
 $858361000 = 95373\frac{1}{2} \text{ tons.}$

ANSWERS.

ton : 50000 tons :: 9000 cub. ft. : ?  $50000 \times 450000000 \div 4 = 112500000$  hours, or 12842 years

8.

000 tons : 3000 tons :: 48 acres : ?  $3000 \times 48 \div 18 = 8000$  acres.

COMPOUND PROPORTION.

ANSWER.	No.	ANSWER.
£240 principal	(2)	£ ? principal
16 months		£5 interest.
£64 interest		1 year = 12 mo.
—		—
£ ? interest		£450 principal
£60 principal		£30 interest
6 months		16 months
: 60 :: £64 : ?		30 : 5 :: £450 : ?
: 6		12 : 16
Divide 240 and 64 by 8		Divide 30 and 450 by 30
: 60 :: 8 : ?		„ 12 and 16 by 4
: 6		1 : 5 :: 15 : ?
Divide 30 and 60 by 30		3 : 4
16 and 8 by 8 ?		Divide 3 and 15 by 3
: 2 :: 1 : ?		1 : 5 :: 5 : ?
: 6		1 : 4
Divide 2 and 2 by 2		$5 \times 5 \times 4 = £100.$
: 1 :: 1 : ?		
: 6		
ult, £6, is the required number.		

No.      ANSWERS.

- (3)      15 cwt.  
          40 miles  
          10 crowns=50s.

---

? s.

6 cwt.

32 miles

15 : 6 :: 50s. : ?

40 : 32

Divide 15 and 6 by 3.

"      40 and 50 by 10

5 : 2 :: 5 : ?

4 : 32

Divide 5 and 5 by 5

"      4 and 32 by 4

1 : 2 :: 1 : ?

1 : 8

2s.  $\times$  8=16s.

- (4)      20 cwt.  
          50 miles  
          £5

---

£ ?

40 cwt.

100 miles

20 : 40 :: £5 : ?

50 : 100

Divide 20 and 40 by 20

"      50 and 100 by 50

1 : 2 :: 5 : ?

1 : 2

2  $\times$  5  $\times$  2=£20.

No.      ANSWERS.

- (5)      200 lbs.  
          40 miles  
          3s.=36d.

---

? lbs.

60 miles

£22 14s. 6d.=545

60 : 40 :: 200lbs

36 : 5454

Divide 60 and 40 by

6 : 4 :: 200 :

36 : 5454

Divide 36 and 4 by

6 : 1 :: 200 :

9 : 5454

Divide 9 and 5454 by

6 : 1 :: 200 :

1 : 606

Divide 6 and 606 by

1 : 1 :: 200 :

1 : 101

200  $\times$  101=20200

- (6)      286 lbs.  
          20 miles  
          3s.=36d.

---

? miles

4 cwt. 3 qrs.=532l

£32 6s. 8d.=7760d

532 : 286 :: 20

36 : 7760

Divide 532 and 5760

"      36 and 20 by

133 : 286 :: 5 :

9 : 1940

5  $\times$  286  $\times$  1940 = 2774

---

133  $\times$  9      11

2317-629 miles, the a

## ANSWERS.

28 feet

15 days

68 men

—  
? men

32 feet

8 days

32 :: 68 men : ?

15

le 28 and 68 by 4

8 and 32 by 8

: 4 :: 17 : ?

: 15

 $7 \times 4 \times 15 =$  $\div 7 = 145\frac{1}{2}$  men.

b.

ards long

yd.=5 quarters wide

bs.

ards long

d.=4 quarters wide

: 45 :: 11b. : ?

: 4

ide 3 and 45 by 3

: 15 :: 1 : ?

: 4

ide 5 and 15 by 5

: 3 :: 1 : ?

: 4

s.  $\times$  3lbs.=12lbs.

## No.

## ANSWERS.

(9) 3 lbs.

10 yards long

 $1\frac{1}{2}$  yds.=6 quarters wide—  
? lbs.

100 yards long

 $1\frac{1}{2}$  yds.=5 quarters wide

10 : 100 :: 3lbs. : ?

6 : 5

Divide 10 and 100 by 10

" 6 and 3 by 3

1 : 10 :: 1 : ?

2 : 5

Divide 2 and 10 by 2

1 : 5 :: 1 : ?

1 : 5

5lbs.  $\times$  5lbs.=25lbs.(10)  $\begin{matrix} \text{cwt.} & \text{cwt.} & \text{cwt.} \\ 80000 & -4500 & =75500 \end{matrix}$ 

6 days

18 horses

4500 cwt.

—  
? horses

75500 cwt.

3 days

4500 : 75500 :: 18 : ?

3 : 6

Divide 4500 and 75500 by 500

" 3 and 6 by 3

9 : 151 :: 18 : ?

1 : 2

Divide 9 and 18 by 9

1 : 151 :: 2 : ?

1 : 2

 $\begin{matrix} \text{horses.} & \text{horses.} \end{matrix}$  $2 \times 151 \times 2 = 604$

No.      ANSWER.

- (11) 3 masters  
 8 apprentices  
 £36  
 5 weeks  
 6 days = 12 half-days  
 —  
 £ ?  
 5 masters  
 10 apprentices  
 8 weeks  
 5½ days = 11 half-days  
 3 : 5 :: £36 : ?  
 8 : 10  
 5 : 8  
 12 : 11  
 Divide 12 and 36 by 12  
 „ 8 and 8 by 8  
 „ 5 and 10 by 5  
 3 : 5 :: 3 : ?  
 1 : 2  
 1 : 1  
 1 : 11  
 Divide 3 and 3 by 3  
 1 : 5 :: 1 : ?  
 1 : 2  
 1 : 1  
 1 : 11  
 £5 × 2 × 11 = £110

No.      ANSWER.

- (12) 6 shoemakers  
 4 weeks  
 36 pairs of men's shoes  
 —  
 ? pairs of men's shoes  
 18 shoemakers  
 5 weeks  
 6 : 18 :: 36p.  
 4 : 5  
 Divide 6 and 18 by 6  
 „ 4 and 36 by 4  
 1 : 3 :: 9 : ?  
 1 : 5  
 9 × 3 × 5 = 135 pairs of shoes  
 p. of m. p. of m. p. of wks  
 36 : 135 :: 24 : ?  
 Divide 36 and 24 by 3  
 3 : 135 :: 2 : ?  
 Divide 3 and 135 by 3  
 1 : 45 :: 2 : ?  
 45 × 2 = 90 pairs of women's shoes correspond to  
 pairs of men's shoes.

ANSWERS.

21 horses  
5 days  
44 tons  
—  
? horses  
132 tons  
18 days  
18 : 5 :: 12 : ?  
14 : 132  
de 44 and 132 by 11  
18 : 5 :: 12 : ?  
4 : 12  
vide 4 and 12 by 4  
18 : 5 :: 12 : ?  
1 : 3  
vide 18 and 3 by 3  
6 : 5 :: 12 : ?  
1 : 1  
ses  $\times 5 \div 6 = 10$  horses.

27 shill.

4 men

7 days

—  
? shill.

14 men

10 days

: 14 :: 27s. : ?

: 10

ide 4 and 10 by 2

7 and 14 by 7

2 : 2 :: 27 : ?

1 : 5

vide 2 and 2 by 2

1 : 1 :: 27 : ?

1 : 5

= 135s., or £6 15s.

No.

ANSWERS.

(15) 120 bushels  
14 horses  
56 days  
—  
? days  
90 bushels  
6 horses  
120 : 90 :: 56 days : ?  
6 : 14  
Divide 120 and 90 by 30  
,, 6 and 14 by 2  
4 : 3 :: 56 : ?  
3 : 7  
Divide 4 and 56 by 4  
,, 3 and 3 by 3  
1 : 1 :: 14 : ?  
1 : 7  
14 days  $\times 7 = 98$  days

(16) 130 miles  
3 days  
14 hours long  
—  
? days  
7 hours long  
390 miles  
130 : 390 :: 3 days : ?  
7 : 14  
Divide 130 and 390 by 130  
,, 7 and 14 by 7  
1 : 3 :: 3 : ?  
1 : 2  
3 days  $\times 3 \times 2 = 18$  days.



No.      ANSWER.

(17) 10 ounces  
 1s.  $10\frac{1}{2}d.$  =  $45\frac{1}{2}d.$  per stone  
 1d.

---

? d.

3 lbs. 12 oz. = 60 ounces  
 2s. 6d. =  $60\frac{1}{2}d.$  per stone  
 10 : 60 :: 1d. : ?  
 45 : 60

Divide 10 and 60 by 10

„ 45 and 60 by 15

1 : 6 :: 1 : ?

3 : 4

Divide 3 and 6 by 3

1 : 2 :: 1 : ?

1 : 4

$2d. \times 4 = 8d.$

(18) 5 compositors

16 days

14 hours long

20 sheets

24 pages

50 lines

40 letters

---

? days

7 hours long

10 compositors

40 sheets

16 pages

60 lines

50 letters

10 : 5 :: 16 days : ?

7 : 14

20 : 20

24 : 16

50 : 60

40 : 50

No.      ANSWER.

Divide 10 and 5 by 5

„ 7 and 14 by 7

„ 20 and 40 by 20

„ 24 and 16 by 8

„ 50 and 60 by 10

„ 40 and 50 by 10

2 : 1 :: 16 : ?

1 : 2

1 : 2

3 : 2

5 : 6

4 : 5

Divide 2 and 2 by 2

„ 3 and 6 by 3

„ 5 and 5 by 5

„ 4 and 2 by 2

1 : 1 :: 16 : ?

1 : 1

1 : 1

1 : 2

1 : 2

2 : 1

Divide 2 and 2 by 2

1 : 1 :: 16 : ?

1 : 1

1 : 1

1 : 1

1 : 2

1 : 1

16 days  $\times$  2 = 32 days.

## PRACTICE.

1. 7*l*. 2*s*. 7½*d*. No. 2. 1*l*. 0*s*. 0½*d*. No. 3. 3*l*. 6*s*. 6*d*.  
 18*l*. 4*s*. 3*d*. No. 5. 0*l*. 10*s*. 6*d*. No. 6. 3*l*. 9*s*. 6*d*.  
 1*l*. 15*s*. 7*d*. No. 8. 0*l*. 14*s*. 10½*d*. No. 9. 15*l*. 15*s*. 6½*d*.  
 5*l*. 15*s*. 4½*d*. No. 11. 2*l*. 11*s*. 2½*d*. No. 12. 1*l*. 8*s*. 9*d*.

$$\begin{array}{r|l} d. = \frac{1}{12} & 6423 \text{ at } 1d. \\ 2,0 & \underline{53,5 \quad 3} \\ & \underline{\underline{£26 \quad 15 \quad 3}} \end{array}$$

$$\begin{array}{r|l} 17. \quad 2d. = \frac{1}{6} & 4285 \text{ at } 2d. \\ 2,0 & \underline{71,4 \quad 2} \\ & \underline{\underline{£35 \quad 14 \quad 2}} \end{array}$$

$$\begin{array}{r|l} z. = \frac{1}{4} & 3684 \text{ at } 1\frac{1}{4}d. \\ & 921 \\ 12 & \underline{4605} \\ 2,0 & \underline{38,3 \quad 9} \\ & \underline{\underline{£19 \quad 3 \quad 9}} \end{array}$$

$$\begin{array}{r|l} 18. \quad 2d. = \frac{1}{6} & 6786 \text{ at } 2\frac{1}{4}d. \\ \frac{1}{4}d. = \frac{1}{8} & \underline{1131} \\ & 141 \quad 4\frac{1}{2} \\ 2,0 & \underline{127,2 \quad 4\frac{1}{2}} \\ & \underline{\underline{£63 \quad 12 \quad 4\frac{1}{2}}} \end{array}$$

$$\begin{array}{r|l} \frac{1}{2}d. = \frac{1}{2} & 2786 \text{ at } 1\frac{1}{2}d. \\ 2,0 & \underline{34,8 \quad 3} \\ & \underline{\underline{£17 \quad 8 \quad 3}} \end{array}$$

$$\begin{array}{r|l} \frac{1}{2}d. = \frac{1}{2} & 5963 \text{ at } 1\frac{1}{4}d. \\ \frac{1}{4}d. = \frac{1}{8} & \underline{745 \quad 4\frac{1}{2}} \\ & 124 \quad 2\frac{1}{2} \\ 2,0 & \underline{86,9 \quad 7\frac{1}{2}} \\ & \underline{\underline{£43 \quad 9 \quad 7\frac{1}{2}}} \end{array}$$

$$\begin{array}{r|l} 19. \quad 2d. = \frac{1}{6} & 4388 \text{ at } 2\frac{1}{4}d. \\ \frac{1}{2}d. = \frac{1}{4} & \underline{731 \quad 4} \\ & 182 \quad 10 \\ 2,0 & \underline{91,4 \quad 2} \\ & \underline{\underline{£45 \quad 14 \quad 2}} \end{array}$$

No.	ANSWERS.
20.	$2d. = \frac{1}{8}$   8653 at $2\frac{1}{4}d.$ <hr/> $\frac{1}{2}d. = \frac{1}{4}$   1442 2 $\frac{1}{4}d. = \frac{1}{8}$   360 $6\frac{1}{2}$ 180 $3\frac{1}{4}$ <hr/> 2,0   198,2 $11\frac{1}{4}$ <hr/> £99 2 $11\frac{1}{4}$ <hr/>

21.	$3d. = \frac{1}{4}$   7568 at $3d.$ <hr/> 2,0   189,2 <hr/> £94 12 <hr/>
-----	---

22.	$3d. = \frac{1}{4}$   8543 at $3\frac{1}{4}d.$ <hr/> $\frac{1}{2}d. = \frac{1}{2}$   2135 9 533 $11\frac{1}{4}$ <hr/> 2,0   266,9 $8\frac{1}{4}$ <hr/> £133 9 $8\frac{1}{4}$ <hr/>
-----	---

23.	$3d. = \frac{1}{4}$   2758 at $4\frac{1}{4}d.$ <hr/> $1d. = \frac{1}{8}$   689 6 $\frac{1}{2}d. = \frac{1}{4}$   229 10 57 $5\frac{1}{2}$ <hr/> 2,0   97,6 $9\frac{1}{2}$ <hr/> £48 16 $9\frac{1}{2}$ <hr/>
-----	---

No.	ANSWERS
24.	$4d. = \frac{1}{3}$   5623 at $4\frac{1}{2}d.$ <hr/> $\frac{1}{2}d. = \frac{1}{6}$   1874 4 234 $3\frac{1}{2}$ <hr/> 2,0   210,8 $7\frac{1}{2}$ <hr/> £105 8 $7\frac{1}{2}$ <hr/>

25.	$4d. = \frac{1}{3}$   4278 at $5\frac{1}{2}d.$ <hr/> $1\frac{1}{2}d. = \frac{1}{2}$   1426 0 $\frac{1}{2}d. = \frac{1}{6}$   534 9 89 $1\frac{1}{2}$ <hr/> 2,0   204,9 $10\frac{1}{2}$ <hr/> £102 9 $10\frac{1}{2}$ <hr/>
-----	---

26.	$6d. = \frac{1}{2}$   6496 at $6\frac{1}{2}d.$ <hr/> $\frac{1}{2}d. = \frac{1}{12}$   3248 270 8 <hr/> 2,0   351,8 8 <hr/> £175 18 8 <hr/>
-----	---

27.	$6d. = \frac{1}{2}$   4378 at $6\frac{1}{2}d.$ <hr/> $\frac{1}{2}d. = \frac{1}{6}$   2189 0 273 $7\frac{1}{2}$ <hr/> 2,0   246,2 $7\frac{1}{2}$ <hr/> £123 2 $7\frac{1}{2}$ <hr/>
-----	--

). ANSWERS.

$$\begin{array}{r|l}
 6d. = \frac{1}{2} & 4021 \text{ at } 7\frac{1}{2}d. \\
 1\frac{1}{2}d. = \frac{1}{4} & \begin{array}{r} 2010 \quad 6 \\ 502 \quad 7\frac{1}{2} \end{array} \\
 2,0 & \begin{array}{r} 251,3 \quad 1\frac{1}{2} \\ \hline \pounds 125 \quad 13 \quad 1\frac{1}{2} \end{array}
 \end{array}$$

$$\begin{array}{r|l}
 6d. = \frac{1}{2} & 8642 \text{ at } 8\frac{1}{2}d. \\
 2d. = \frac{1}{3} & \begin{array}{r} 4321 \quad 0 \\ 1440 \quad 4 \\ 180 \quad 0\frac{1}{2} \end{array} \\
 \frac{1}{4}d. = \frac{1}{8} & \begin{array}{r} 594,1 \quad 4\frac{1}{2} \\ \hline 297 \quad 1 \quad 4\frac{1}{2} \end{array}
 \end{array}$$

$$\begin{array}{r|l}
 6d. = \frac{1}{2} & 7643 \text{ at } 8\frac{1}{2}d. \\
 2d. = \frac{1}{3} & \begin{array}{r} 3821 \quad 6 \\ 1273 \quad 10 \\ 477 \quad 8\frac{1}{2} \end{array} \\
 \frac{1}{4}d. = \frac{1}{8} & \begin{array}{r} 557,3 \quad 0\frac{1}{4} \\ \hline \pounds 278 \quad 13 \quad 0\frac{1}{4} \end{array}
 \end{array}$$

$$\begin{array}{r|l}
 6d. = \frac{1}{2} & 8765 \text{ at } 9d. \\
 3d. = \frac{1}{2} & \begin{array}{r} 4382 \quad 6 \\ 2191 \quad 3 \end{array} \\
 2,0 & \begin{array}{r} 657,3 \quad 9 \\ \hline \pounds 328 \quad 13 \quad 9 \end{array}
 \end{array}$$

No. ANSWERS.

$$\begin{array}{r|l}
 32. \quad 6d. = \frac{1}{2} \quad \left. \begin{array}{l} 4d. = \frac{1}{3} \end{array} \right\} & 2011 \text{ at } 10\frac{1}{2}d. \\
 & \begin{array}{r} 1005 \quad 6 \\ 670 \quad 4 \\ 83 \quad 9\frac{1}{2} \end{array} \\
 2,0 & \begin{array}{r} 175,9 \quad 7\frac{1}{2} \\ \hline \pounds 87 \quad 19 \quad 7\frac{1}{2} \end{array}
 \end{array}$$

$$\begin{array}{r|l}
 33 \quad 6d. = \frac{1}{2} \quad \left. \begin{array}{l} 4d. = \frac{1}{3} \end{array} \right\} & 4076 \text{ at } 10\frac{3}{4}d. \\
 & \begin{array}{r} 2038 \quad 0 \\ 1358 \quad 8 \\ 254 \quad 9 \end{array} \\
 2,0 & \begin{array}{r} 365,1 \quad 5 \\ \hline \pounds 182 \quad 11 \quad 5 \end{array}
 \end{array}$$

$$\begin{array}{r|l}
 34. \quad 6d. = \frac{1}{2} & 3687 \text{ at } 11\frac{1}{4}d. \\
 3d. = \frac{1}{3} & \begin{array}{r} 1843 \quad 6 \\ 921 \quad 9 \\ 614 \quad 6 \\ 76 \quad 9\frac{1}{4} \end{array} \\
 2,0 & \begin{array}{r} 345,6 \quad 6\frac{1}{4} \\ \hline \pounds 172 \quad 16 \quad 6\frac{1}{4} \end{array}
 \end{array}$$

No.      ANSWERS.

$$\begin{array}{r|l}
 35. \quad 6d. = \frac{1}{2} \quad \left. \begin{array}{l} \\ 4d. = \frac{1}{3} \end{array} \right\} & 2734 \text{ at } 11\frac{1}{2}d. \\
 & \hline
 & 1367 \quad 0 \\
 & 911 \quad 4 \\
 & 341 \quad 9 \\
 & \hline
 2,0 & 262,0 \quad 1 \\
 & \hline
 & \underline{\underline{£131 \quad 0 \quad 1}}
 \end{array}$$

$$\begin{array}{r|l}
 36. \quad 6d. = \frac{1}{2} \quad \left. \begin{array}{l} \\ 4d. = \frac{1}{3} \end{array} \right\} & 3016 \text{ at } 11\frac{1}{2}d. \\
 & \hline
 & 1508 \quad 0 \\
 & 1005 \quad 4 \\
 & 377 \quad 0 \\
 & 62 \quad 10 \\
 & \hline
 2,0 & 295,3 \quad 2 \\
 & \hline
 & \underline{\underline{£147 \quad 13 \quad 2}}
 \end{array}$$

$$\begin{array}{r|l}
 37. \quad 2s. = \frac{1}{10} & 6428 \text{ at } 2s. \\
 & \hline
 & \underline{\underline{£642 \quad 16}}
 \end{array}$$

$$\begin{array}{r|l}
 38. & 9460 \text{ at } 3s. \\
 & 3 \\
 & \hline
 2,0 & 2838,0 \\
 & \hline
 & \underline{\underline{£1419 \quad 0}}
 \end{array}$$

$$\begin{array}{r|l}
 39. & 7568 \text{ at } 4s. \\
 & 2 \\
 & \hline
 & \underline{\underline{£1513 \quad 12}}
 \end{array}$$

No.      ANSWERS.

$$\begin{array}{r|l}
 40. \quad 5s. = \frac{1}{2} & 3675 \text{ at } 5s. \\
 & \hline
 & \underline{\underline{£918 \quad 15}}
 \end{array}$$

$$\begin{array}{r|l}
 41. & 4103 \text{ at } 6s. \\
 & 3 \\
 & \hline
 & \underline{\underline{£1230 \quad 18}}
 \end{array}$$

$$\begin{array}{r|l}
 42. & 2602 \text{ at } 7s. \\
 & 7 \\
 & \hline
 2,0 & 1821,4 \\
 & \hline
 & \underline{\underline{£910 \quad 14}}
 \end{array}$$

$$\begin{array}{r|l}
 43. & 3604 \text{ at } 8s. \\
 & 4 \\
 & \hline
 & \underline{\underline{£1441 \quad 12}}
 \end{array}$$

$$\begin{array}{r|l}
 44. & 8756 \text{ at } 9s. \\
 & 9 \\
 & \hline
 2,0 & 7880,4 \\
 & \hline
 & \underline{\underline{£3940 \quad 4}}
 \end{array}$$

$$\begin{array}{r|l}
 45. \quad 10s. = \frac{1}{2} & 3601 \text{ at } 10s. \\
 & \hline
 & \underline{\underline{£1800 \quad 10}}
 \end{array}$$

## ANSWERS.

$$10s. = \frac{1}{2} \quad 5768 \text{ at } 11s.$$

$$1s. = \frac{1}{10} \quad \begin{array}{r} 2884 \ 0 \\ 288 \ 8 \\ \hline \end{array}$$

$$\underline{\underline{\pounds 3172 \ 8}}$$

$$2104 \text{ at } 12s.$$

$$\begin{array}{r} 6 \\ \hline \end{array}$$

$$\underline{\underline{\pounds 1262 \ 8}}$$

$$6013 \text{ at } 13s.$$

$$\begin{array}{r} 13 \\ \hline \end{array}$$

$$2,0 \quad \begin{array}{r} 7816,9 \\ \hline \end{array}$$

$$\underline{\underline{\pounds 3908 \ 9}}$$

$$7617 \text{ at } 14s.$$

$$\begin{array}{r} 7 \\ \hline \end{array}$$

$$\underline{\underline{\pounds 5931 \ 18}}$$

$$10s. = \frac{1}{2} \quad 2016 \text{ at } 15s.$$

$$5s. = \frac{1}{2} \quad \begin{array}{r} 1008 \\ 504 \\ \hline \end{array}$$

$$\underline{\underline{\pounds 1512}}$$

## No.

51.

## ANSWERS

$$3687 \text{ at } 16s.$$

$$\begin{array}{r} 8 \\ \hline \end{array}$$

$$\underline{\underline{\pounds 2949 \ 12}}$$

52.

$$1209 \text{ at } 17s.$$

$$\begin{array}{r} 17 \\ \hline \end{array}$$

$$2,0 \ ) \ 2055,3$$

$$\underline{\underline{\pounds 1027 \ 13}}$$

53.

$$4123 \text{ at } 18s.$$

$$\begin{array}{r} 9 \\ \hline \end{array}$$

$$\underline{\underline{\pounds 3710 \ 14}}$$

54.

$$7641 \text{ at } 19s.$$

$$\begin{array}{r} 19 \\ \hline \end{array}$$

$$2,0 \ ) \ 14517,9$$

$$\underline{\underline{\pounds 7258 \ 19}}$$

54.

## SECTION II.

No.

## ANSWERS.

5b.

$$\begin{array}{r|l}
 6d. = \frac{1}{3} & 3468 \text{ at } 3s. 6d. \\
 & 3 \\
 \hline
 & 10404 \\
 & 1784 \\
 \hline
 2,0 & 1218,8 \\
 \hline
 & \underline{\underline{£606 \ 18}}
 \end{array}$$

56.

$$\begin{array}{r|l}
 4s. = \frac{1}{5} & 4976 \text{ at } 4s. 7d. \\
 \hline
 6d. = \frac{1}{8} & 995 \ 4 \ 0 \\
 1d. = \frac{1}{6} & 124 \ 8 \ 0 \\
 & 20 \ 14 \ 8 \\
 \hline
 & \underline{\underline{£1140 \ 6 \ 8}}
 \end{array}$$

57.

$$\begin{array}{r|l}
 3d. = \frac{1}{4} & 5048 \text{ at } 6s. 3\frac{1}{2}d. \\
 & 6 \\
 \hline
 & 30288 \ 0 \\
 \frac{1}{8}d. = \frac{1}{8} & 1262 \ 0 \\
 & 210 \ 4 \\
 \hline
 2,0 & 3176,0 \ 4 \\
 \hline
 & \underline{\underline{£1588 \ 0 \ 4}}
 \end{array}$$

## ANSWERS.

$6d. = \frac{1}{2}$	3162 at 5s. $8\frac{1}{2}d.$
	5
	<hr/>
	15810 0
$2d. = \frac{1}{3}$	1581 0
$\frac{1}{2}d. = \frac{1}{4}$	527 0
$\frac{1}{4}d. = \frac{1}{2}$	131 9
	65 $10\frac{1}{2}$
	<hr/>
2,0	1811,5 $7\frac{1}{2}$
	<hr/>
	<u>£905 15 <math>7\frac{1}{2}</math></u>

$6d. = \frac{1}{2}$	7643 at 8s. 7d.
	8
	<hr/>
	61144 0
$1d. = \frac{1}{6}$	3821 6
	686 11
	<hr/>
2,0	6560,2 5
	<hr/>
	<u>£3280 2 5</u>

$4d. = \frac{1}{2}$	5736 at 9s. $4\frac{1}{2}d.$
	9
	<hr/>
	51624 0
$\frac{1}{2}d. = \frac{1}{6}$	1912 0
$\frac{1}{4}d. = \frac{1}{2}$	239 0
	119 6
	<hr/>
2,0	5389,4 6
	<hr/>
	<u>£2694 14 6</u>



No.

## ANSWERS.

61.

$6d. = \frac{1}{2}$	3987 at 9s. $8\frac{1}{2}d.$
	9
	<hr/>
	35883
$2d. = \frac{1}{2}$	1993 6
$\frac{1}{4}d. = \frac{1}{4}$	664 6
	88 $0\frac{1}{2}$
	<hr/>
2,0	3862,4 $0\frac{1}{2}$
	<hr/>
	<u><u>£1981 4 <math>0\frac{1}{2}</math></u></u>

62.

$4d. = \frac{1}{2}$	6426 at 10s. $6\frac{1}{2}d.$
	10
	<hr/>
	64260 0
$2d. = \frac{1}{2}$	2142 0
$\frac{1}{4}d. = \frac{1}{4}$	1071 0
	183 $10\frac{1}{2}$
	<hr/>
2,0	6760,6 $10\frac{1}{2}$
	<hr/>
	<u><u>£3380 6 <math>10\frac{1}{2}</math></u></u>

63.

$6d. = \frac{1}{2}$	8650 at 11s. $9\frac{1}{2}d.$
	11
	<hr/>
	95150 0
$3d. = \frac{1}{2}$	4325 0
$\frac{1}{2}d. = \frac{1}{2}$	2162 6
	360 5
	<hr/>
2,0	10199,7 11
	<hr/>
	<u><u>£5099 17 11</u></u>

## ANSWERS.

$$\begin{array}{r|l}
 \begin{array}{l} 6d. = \frac{1}{4} \\ 4d. = \frac{1}{4} \end{array} \} & \begin{array}{l} 1201 \text{ at } 12s. \ 10d. \\ 12 \\ \hline 14412 \ 0 \\ 600 \ 6 \\ 400 \ 4 \\ \hline 15412 \ 10 \\ \hline 20 \end{array} \\
 & \begin{array}{l} \hline \pounds 770 \ 12 \ 10 \\ \hline \hline \end{array}
 \end{array}$$

$$\begin{array}{r|l}
 \begin{array}{l} 6d. = \frac{1}{4} \\ 1\frac{1}{2}d. = \frac{1}{4} \end{array} \} & \begin{array}{l} 2768 \text{ at } 13s. \ 7\frac{1}{2}d. \\ 13 \\ \hline 35984 \\ 1384 \\ 346 \\ \hline 2,0 \end{array} \\
 & \begin{array}{l} \hline 3771,4 \\ \hline \pounds 1885 \ 4 \\ \hline \hline \end{array}
 \end{array}$$

$$\begin{array}{r|l}
 \begin{array}{l} 6d. = \frac{1}{4} \\ 8d. = \frac{1}{4} \\ \frac{1}{2}d. = \frac{1}{4} \end{array} \} & \begin{array}{l} 6475 \text{ at } 14s. \ 9\frac{1}{2}d. \\ 14 \\ \hline 90650 \\ 3237 \ 6 \\ 1618 \ 9 \\ 404 \ 8\frac{1}{2} \\ \hline 2,0 \end{array} \\
 & \begin{array}{l} \hline 9591,0 \ 11\frac{1}{2} \\ \hline \pounds 4795 \ 10 \ 11\frac{1}{2} \\ \hline \hline \end{array}
 \end{array}$$

No.

ANSWERS.

67.

$$\begin{array}{r|l}
 6d. = \frac{1}{2} & 4687 \text{ at } 15s. \frac{7}{2}d. \\
 & 15 \\
 \hline
 & 70805 \\
 1d. = \frac{1}{4} & 2343 \quad 6 \\
 & 390 \quad 7 \\
 \hline
 2,0 & 7803,9 \quad 1 \\
 \hline
 & \underline{\underline{£3651 \quad 19 \quad 1}}
 \end{array}$$

68.

$$\begin{array}{r|l}
 6d. = \frac{1}{2} & 9621 \text{ at } 16s. 9\frac{1}{2}d. \\
 & 16 \\
 \hline
 & 153936 \\
 3d. = \frac{1}{2} & 4810 \quad 6 \\
 \frac{1}{4}d. = \frac{1}{12} & 2405 \quad 3 \\
 & 200 \quad 5\frac{1}{2} \\
 \hline
 2,0 & 6135,2 \quad 2\frac{1}{2} \\
 \hline
 & \underline{\underline{£8067 \quad 12 \quad 2\frac{1}{2}}}
 \end{array}$$

69.

$$\begin{array}{r|l}
 6d. = \frac{1}{2} & 4103 \text{ at } 17s. 8\frac{1}{2}d. \\
 & 17 \\
 \hline
 & 69751 \\
 2d. = \frac{1}{3} & 2051 \quad 6 \\
 \frac{1}{2}d. = \frac{1}{4} & 683 \quad 10 \\
 \frac{1}{4}d. = \frac{1}{2} & 170 \quad 11\frac{1}{2} \\
 & 85 \quad 5\frac{1}{2} \\
 \hline
 2,0 & 7274,2 \quad 9\frac{1}{2} \\
 \hline
 & \underline{\underline{£3637 \quad 2 \quad 9\frac{1}{2}}}
 \end{array}$$

N.B.—The Exercises 65. to 72, and 82 to 87, inclusive, are here with the number multiplied by the shillings (units and tens) in one merely to save space, and not as examples.

## ANSWERS.

$$\begin{array}{r|l}
 3d. = \frac{1}{4} & 2464 \text{ at } 18s. 4\frac{1}{4}d. \\
 & 18 \\
 \hline
 & 44852 \\
 1d. = \frac{1}{8} & 616 \quad 0 \\
 \frac{1}{4}d. = \frac{1}{4} & 205 \quad 4 \\
 & 51 \quad 4 \\
 \hline
 2,0 & 4522,4 \quad 8 \\
 \hline
 & \underline{\underline{\pounds 2261 \quad 4 \quad 8}}
 \end{array}$$

$$\begin{array}{r|l}
 4d. = \frac{1}{2} \} & 3102 \text{ at } 18s. 5\frac{1}{2}d. \\
 1\frac{1}{2}d. = \frac{1}{2} \} & 18 \\
 \hline
 & 55836 \\
 & 1034 \\
 & 387 \quad 9 \\
 \hline
 2,0 & 5725,7 \quad 9 \\
 \hline
 & \underline{\underline{\pounds 2862 \quad 17 \quad 9}}
 \end{array}$$

$$\begin{array}{r|l}
 6d. = \frac{1}{2} & 6765 \text{ at } 19s. 7\frac{1}{4}d. \\
 & 19 \\
 \hline
 & 128535 \quad 0 \\
 1d. = \frac{1}{6} & 3382 \quad 6 \\
 \frac{1}{4}d. = \frac{1}{4} & 563 \quad 9 \\
 & 140 \quad 11\frac{1}{4} \\
 \hline
 2,0 & 13262,2 \quad 2\frac{1}{4} \\
 \hline
 & \underline{\underline{\pounds 6631 \quad 2 \quad 2\frac{1}{4}}}
 \end{array}$$

No.

## ANSWERS.

73.

$$\begin{array}{l} 5s. = \frac{1}{4} \\ 4s. = \frac{1}{5} \end{array} \}$$

7964 at 7l. 9s. 6d.

7

55748

1991 0

1592 16

199 2

£59590 18

$$6d. = \frac{1}{8}$$

74.

$$\begin{array}{l} 10s. 0d. = \frac{1}{2} \\ 6s. 8d. = \frac{1}{3} \end{array} \}$$

4679 at 8l. 17s. 8d.

8

37432 0 0

2339 10 0

1559 13 4

233 19 0

£41565 2 4

$$1s. 0d. = \frac{1}{17}$$

75.

$$\begin{array}{l} 10s. 0d. = \frac{1}{2} \\ 4s. 0d. = \frac{1}{3} \end{array} \}$$

8742 at 4l. 16s. 5½d.

4

34968 0 0

4371 0 0

1748 8 0

874 4 0

145 14 0

36 8 6

18 4 3

£42161 18 9

$$2s. 0d. = \frac{1}{3}$$

$$4d. = \frac{1}{6}$$

$$1d. = \frac{1}{12}$$

$$\frac{1}{8}d. = \frac{1}{24}$$

## ANSWERS.

10s. 0d. = $\frac{1}{2}$	2598 at 9l. 12s. 8 $\frac{1}{2}$ d.
	9
	<hr/>
	23382 0 0
2s. 0d. = $\frac{1}{5}$	1299 0 0
6d. = $\frac{1}{4}$	259 16 0
2d. = $\frac{1}{2}$	64 19 0
$\frac{1}{4}$ d. = $\frac{1}{8}$	21 13 0
	2 14 1 $\frac{1}{2}$
	<hr/>
	£25080 2 1 $\frac{1}{2}$
	<hr/>

10s. 0d. = $\frac{1}{2}$	8764 at 10l. 17s. 6 $\frac{1}{2}$ d.
	10
	<hr/>
	87640 0 0
5s. 0d. = $\frac{1}{4}$	4382 0 0
2s. 0d. = $\frac{1}{5}$	2191 0 0
6d. = $\frac{1}{4}$	876 8 0
$\frac{1}{4}$ d. = $\frac{1}{8}$	219 2 0
	27 7 9
	<hr/>
	£95335 17 9
	<hr/>

10s. 0d. = $\frac{1}{2}$	}	2687 at 12l. 14s. 7d.
4s. 0d. = $\frac{1}{5}$		12
		<hr/>
		32244 0 0
		1343 10 0
6d. = $\frac{1}{4}$		537 8 0
1d. = $\frac{1}{2}$		67 3 6
		11 3 11
		<hr/>
		£34203 5 5
		<hr/>

No.

## ANSWERS.

79.	$10s. 0d. = \frac{1}{2}$	9648 at 8l. 11s. $4\frac{1}{2}d.$ 8
		<hr/>
	$1s. 3d. = \frac{1}{3}$	77184 0
	$1\frac{1}{2}d. = \frac{1}{10}$	4824 0
		608 0
		60 6
		<hr/>
		£82671 6
		<hr/>

80.	$10s. 0d. = \frac{1}{2}$	2784 at 11l. 10s. 2d. 11
		<hr/>
		30624 0
	$2d. = \frac{1}{50}$	1392 0
		23 4
		<hr/>
		£32039 4
		<hr/>

81.	$10s. 0d. = \frac{1}{2}$	7204 at 12l. 16s. 7d. 12
		<hr/>
		86448 0 0
	$5s. 0d. = \frac{1}{4}$	3602 0 0
	$1s. 0d. = \frac{1}{5}$	1801 0 0
	$6d. = \frac{1}{8}$	360 4 0
	$1d. = \frac{1}{10}$	180 2 0
		30 0 4
		<hr/>
		£92421 6 4
		<hr/>

## ANSWERS.

$10s. 0d. = \frac{1}{2}$	}	4121 at 13l. 14s. 8d.
$4s. 0d. = \frac{1}{2}$		18
		<hr/>
		53573 0 0
		2060 10 0
$8d. = \frac{1}{2}$		824 4 0
		137 7 4
		<hr/>
		<u>£56595 1 4</u>

$10s. 0d. = \frac{1}{2}$	}	3145 at 14l. 17s. $9\frac{1}{4}d.$
		14
		<hr/>
		44030 0 0
$5s. 0d. = \frac{1}{2}$		1572 10 0
$2s. 6d. = \frac{1}{2}$		786 5 0
$3d. = \frac{1}{10}$		393 2 6
$\frac{1}{4}d. = \frac{1}{12}$		39 6 3
		3 5 $6\frac{1}{4}$
		<hr/>
		<u>£46824 6 <math>3\frac{1}{4}</math></u>

$10s. 0d. = \frac{1}{2}$	}	6876 at 15l. 19s. 7d.
$4s. 0d. = \frac{1}{2}$		15
		<hr/>
		103140 9
$5s. 0d. = \frac{1}{2}$		3438 0
		1719 0
$6d. = \frac{1}{2}$		1375 4
$1d. = \frac{1}{2}$		171 18
		28 13
		<hr/>
		<u>£109872 15</u>



No.

## ANSWERS.

85.	$10s. 0d. = \frac{1}{2}$	9684 at 16l. 18s. 6½d. 16
		<hr/>
		154944 0 0
	$5s. 0d. = \frac{1}{2}$	4842 0 0
	$2s. 6d. = \frac{1}{2}$	2421 0 0
	$1s. 0d. = \frac{1}{2}$	1210 10 0
	$\frac{1}{4}d. = \frac{1}{16}$	484 4 0
		80 5 3
		<hr/>
		£163931 19 3
		<hr/>

86.	$10s. 0d. = \frac{1}{2}$	7780 at 17l. 13s. 4d. 17
		<hr/>
		132260 0 0
	$3s. 4d. = \frac{1}{2}$	8890 0 0
		1296 13 4
		<hr/>
		£137446 13 4
		<hr/>

87	$10s. 0d. = \frac{1}{2}$	4627 at 18l. 14s. 5d. 18
	$4s. 0d. = \frac{1}{2}$	<hr/>
		83286 0 0
	$5d. = \frac{1}{24}$	2313 10 0
		925 8 0
		96 7 11
		<hr/>
		£86621 5 11
		<hr/>

## ANSWERS.

	cwt.	qr.	lb.	£	s.	d.
.	24	2	7	at	2	16 7
2 qrs. = $\frac{1}{2}$				£	s.	d.
				2	16	7
						12
						<hr/>
				83	19	0
						2
						<hr/>
7 lbs. = $\frac{1}{8}$				67	18	0
				1	8	3 $\frac{1}{2}$
				0	8	6 $\frac{1}{4}$
						<hr/>
				£60	9	9 $\frac{3}{4}$

cwt.	qr.	lb.	£	s.	d.
14	1	8	at	3	14 6
			£	s.	d.
1 qr.	=	$\frac{1}{4}$	3	14	6
					2
			<hr/>		
			7	9	0
					7
			<hr/>		
			52	8	0
7 lb.	=	$\frac{1}{4}$	0	18	$7\frac{1}{2}$
1 lb.	=	$\frac{1}{7}$	0	4	$7\frac{3}{4}$
			0	0	$7\frac{3}{4}$
			<hr/>		
			£53	6	11

<b>No.</b>	<b>ANSWERS.</b>
------------	-----------------

90.	cwt.	qr.	lb.	at	£	s.	d.
	7	3	6		4	15	8
2 qrs. = $\frac{1}{2}$					£	s.	d.
					4	15	8
							7
					<hr/>		
					33	9	8
1 qr. = $\frac{1}{4}$					2	7	10
4 lbs. = $\frac{1}{8}$					1	3	11
2 lbs. = $\frac{1}{4}$					0	3	5
					0	1	8 $\frac{1}{2}$
					<hr/>		
					£37	6	6 $\frac{1}{2}$

	cwt.	qr.	lb.	£	s.	d.
91.	16	2	18	at	5	14 9
2 qrs. = $\frac{1}{2}$				£	s.	d.
				5	14	9
						8
				45	18	0
						2
14 lbs. = $\frac{1}{4}$				91	18	0
2 lbs. = $\frac{1}{7}$				2	17	4 $\frac{1}{2}$
2 lbs. = $\frac{1}{7}$				0	14	4
				0	2	0 $\frac{1}{2}$
				0	2	0 $\frac{1}{2}$
				£95	11	9 $\frac{1}{2}$

No.	ANSWERS.					
	cwt.	qr.	lb.	£	s.	d.
92.	27	1	16 at	6	13	2
				£	s.	d.
1 qr. = $\frac{1}{4}$				6	13	2
						9
				59	18	6
						3
				179	15	6
14 lbs. = $\frac{1}{2}$				1	13	3 $\frac{1}{2}$
2 lbs. = $\frac{1}{7}$				0	16	7 $\frac{3}{4}$
				0	2	4 $\frac{1}{2}$
				£182	7	9 $\frac{3}{4}$

No.	ANSWERS.					
	cwt.	qr.	lb.	£	s.	d.
94.	35	1	8 at	6	10	6
				£	s.	d.
1 qr. = $\frac{1}{4}$				6	10	6
						7
				45	13	6
						5
				228	7	6
7 lbs. = $\frac{1}{4}$				1	12	7 $\frac{1}{2}$
1 lb. = $\frac{1}{7}$				0	8	1 $\frac{1}{2}$
				0	1	1 $\frac{1}{2}$
				£230	9	5

	cwt.	qr.	lb.	£	s.	d.
93.	32	2	14 at	7	19	8
				£	s.	d.
2 qrs. = $\frac{1}{2}$				7	19	8
						4
				31	18	8
						8
				255	9	4
14 lbs. = $\frac{1}{4}$				3	19	10
				0	19	11 $\frac{1}{2}$
				£260	9	1 $\frac{1}{2}$

	cwt.	qr.	lb.	£	s.	d.
95.	36	2	7 at	4	12	8 $\frac{1}{2}$
				£	s.	d.
2 qrs. = $\frac{1}{2}$				4	12	8 $\frac{1}{2}$
						4
				18	10	10
						9
				166	17	6
7 lbs. = $\frac{1}{8}$				2	6	4 $\frac{1}{2}$
				0	5	9 $\frac{1}{2}$
				£169	9	7 $\frac{1}{2}$

## ANSWERS.

wt. qr. lb. £ s. d.  
40 3 9 at 9 16 1 $\frac{1}{4}$

s. =  $\frac{1}{2}$  | £ s. d.  
9 16 1 $\frac{1}{4}$   
10

98 1 0 $\frac{1}{2}$   
4

392 4 2

qr. =  $\frac{1}{2}$  | 4 18 0 $\frac{1}{2}$

s. =  $\frac{1}{4}$  | 2 9 0 $\frac{1}{4}$

s. =  $\frac{1}{14}$  | 0 12 3

0 3 6

£400 6 11 $\frac{3}{4}$

wt. qr. lb. £ s. d.  
42 2 16 at 8 14 7

rs. =  $\frac{1}{2}$  | £ s. d.  
8 14 7  
6

52 7 6  
7

366 12 6

bs. =  $\frac{1}{4}$  | 4 7 3 $\frac{1}{2}$

bs. =  $\frac{1}{7}$  | 1 1 9 $\frac{3}{4}$

0 3 1 $\frac{1}{4}$

£372 4 8 $\frac{1}{2}$

## No.

## ANSWERS.

98. cwt. qr. lb. £ s. d.  
45 1 14 at 9 15 6 $\frac{3}{4}$

1 qr. =  $\frac{1}{4}$  | £ s. d.  
9 15 6 $\frac{3}{4}$   
9

88 0 0 $\frac{3}{4}$   
5

14 lbs. =  $\frac{1}{2}$  | 440 0 3 $\frac{1}{2}$

2 8 10 $\frac{1}{2}$

1 4 5 $\frac{1}{4}$

£443 13 7 $\frac{1}{2}$

99. cwt. qr. lb. £ s. d.  
48 2 4 at 4 17 8

2 qrs. =  $\frac{1}{2}$  | £ s. d.  
4 17 8  
6

29 6 0  
8

234 8 0

4 lbs. =  $\frac{1}{14}$  | 2 8 10

0 3 5 $\frac{3}{4}$

£237 0 3 $\frac{3}{4}$

No.

## ANSWERS.

100.  $10s. 0d. = \frac{1}{3}$  |  $4786\frac{1}{3}$  at  $3l. 10s. 6d.$   
 $3$

---

$6d. = \frac{1}{20}$  |  $14858 \ 0 \ 0$   
 $2393 \ 0 \ 0$   
 $119 \ 18 \ 0$   
 $\frac{1}{3} =$  |  $1 \ 15 \ 3$

---

$\underline{\underline{\pounds 16872 \ 8 \ 3}}}$

101.  $6s. 8d. = \frac{1}{3}$  } |  $7641\frac{1}{3}$  at  $4l. 9s. 7d.$   
 $2s. 6d. = \frac{1}{6}$  } |  $4$

---

$5d. = \frac{1}{6}$  |  $30564 \ 0 \ 0$   
 $2547 \ 0 \ 0$   
 $955 \ 2 \ 6$   
 $159 \ 3 \ 9$   
 $\frac{1}{3} =$  |  $1 \ 9 \ 10\frac{1}{2}$

---

$\underline{\underline{\pounds 34226 \ 16 \ 1\frac{1}{2}}}$

102.  $5s. 0d. = \frac{1}{4}$  |  $8469\frac{3}{4}$  at  $\begin{array}{r} s. \ d. \\ 8 \ 6 \\ 2 \end{array}$

---

$2s. 6d. = \frac{1}{3}$  |  $2117 \ 5 \ 0$   
 $1058 \ 12 \ 6$   
 $1s. 0d. = \frac{1}{3}$  |  $423 \ 9 \ 0$   
 $\frac{1}{3} =$  |  $0 \ 5 \ 8$

---

$\underline{\underline{\pounds 3599 \ 12 \ 2}}}$

$\begin{array}{r} 3) 17 \ 0 \\ \underline{5 \ 8} \end{array}$

## ANSWERS.

$5s. 0d. = \frac{1}{4}$ $6d. = \frac{1}{10}$ $1\frac{1}{2}d. = \frac{1}{4}$ $\frac{1}{2}d. = \frac{1}{8}$ $\frac{1}{2} =$	$4210\frac{1}{4}$ <hr style="width: 100%;"/> $1052 \ 10 \ 0$ $105 \ 5 \ 0$ $26 \ 6 \ 8$ $4 \ 7 \ 8\frac{1}{2}$ $0 \ 4 \ 2\frac{3}{4}$ <hr style="width: 100%;"/> $\underline{\underline{\pounds 1188 \ 13 \ 2\frac{1}{4}}}$	at	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: right;"><i>s.</i></td> <td style="text-align: right;"><i>d.</i></td> </tr> <tr> <td style="text-align: right;">5</td> <td style="text-align: right;">7<math>\frac{3}{4}</math></td> </tr> <tr> <td></td> <td style="text-align: right;">3</td> </tr> <tr> <td colspan="2"><hr style="width: 100%;"/></td> </tr> <tr> <td style="text-align: right;">4)</td> <td style="text-align: right;">16 <math>11\frac{1}{4}</math></td> </tr> <tr> <td></td> <td style="text-align: right;">4 <math>2\frac{3}{4}</math></td> </tr> <tr> <td></td> <td style="text-align: right;"><hr style="width: 100%;"/></td> </tr> </table>	<i>s.</i>	<i>d.</i>	5	7 $\frac{3}{4}$		3	<hr style="width: 100%;"/>		4)	16 $11\frac{1}{4}$		4 $2\frac{3}{4}$		<hr style="width: 100%;"/>
<i>s.</i>	<i>d.</i>																
5	7 $\frac{3}{4}$																
	3																
<hr style="width: 100%;"/>																	
4)	16 $11\frac{1}{4}$																
	4 $2\frac{3}{4}$																
	<hr style="width: 100%;"/>																

$1s. 0d. = \frac{1}{4}$ $2s. 6d. = \frac{1}{2}$ $5d. = \frac{1}{8}$ $\frac{1}{2}d. = \frac{1}{20}$ $\frac{7}{8} =$	$8659\frac{7}{8}$ <hr style="width: 100%;"/> $2164 \ 15 \ 0$ $1082 \ 7 \ 6$ $180 \ 7 \ 11$ $9 \ 0 \ 4\frac{1}{2}$ $0 \ 6 \ 11\frac{1}{2}$ <hr style="width: 100%;"/> $\underline{\underline{\pounds 3436 \ 17 \ 9}}}$	at	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: right;"><i>s.</i></td> <td style="text-align: right;"><i>d.</i></td> </tr> <tr> <td style="text-align: right;">7</td> <td style="text-align: right;">11<math>\frac{1}{2}</math></td> </tr> <tr> <td></td> <td style="text-align: right;">7</td> </tr> <tr> <td colspan="2"><hr style="width: 100%;"/></td> </tr> <tr> <td style="text-align: right;">8)</td> <td style="text-align: right;">55 <math>6\frac{1}{2}</math></td> </tr> <tr> <td></td> <td style="text-align: right;">6 <math>11\frac{1}{2}</math></td> </tr> <tr> <td></td> <td style="text-align: right;"><hr style="width: 100%;"/></td> </tr> </table>	<i>s.</i>	<i>d.</i>	7	11 $\frac{1}{2}$		7	<hr style="width: 100%;"/>		8)	55 $6\frac{1}{2}$		6 $11\frac{1}{2}$		<hr style="width: 100%;"/>
<i>s.</i>	<i>d.</i>																
7	11 $\frac{1}{2}$																
	7																
<hr style="width: 100%;"/>																	
8)	55 $6\frac{1}{2}$																
	6 $11\frac{1}{2}$																
	<hr style="width: 100%;"/>																

$10s. 0d. = \frac{1}{2}$ $2s. 6d. = \frac{1}{4}$ $\frac{1}{2}d. = \frac{1}{20}$ $\frac{1}{2} =$	$4286\frac{1}{2}$ $9$ <hr style="width: 100%;"/> $88574$ $2143 \ 0 \ 0$ $535 \ 15 \ 0$ $8 \ 18 \ 7$ $7 \ 14 \ 0\frac{1}{2}$ <hr style="width: 100%;"/> $\underline{\underline{\pounds 41269 \ 7 \ 7\frac{1}{2}}}$	at	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: right;"><i>£</i></td> <td style="text-align: right;"><i>s.</i></td> <td style="text-align: right;"><i>d.</i></td> </tr> <tr> <td style="text-align: right;">9</td> <td style="text-align: right;">12</td> <td style="text-align: right;">6<math>\frac{1}{4}</math></td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;">4</td> </tr> <tr> <td colspan="3"><hr style="width: 100%;"/></td> </tr> <tr> <td style="text-align: right;">5)</td> <td style="text-align: right;">38</td> <td style="text-align: right;">10 <math>2</math></td> </tr> <tr> <td></td> <td style="text-align: right;"><hr style="width: 100%;"/></td> <td></td> </tr> <tr> <td></td> <td style="text-align: right;">£7</td> <td style="text-align: right;">14 <math>0\frac{1}{2}</math></td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;"><hr style="width: 100%;"/></td> </tr> </table>	<i>£</i>	<i>s.</i>	<i>d.</i>	9	12	6 $\frac{1}{4}$			4	<hr style="width: 100%;"/>			5)	38	10 $2$		<hr style="width: 100%;"/>			£7	14 $0\frac{1}{2}$			<hr style="width: 100%;"/>
<i>£</i>	<i>s.</i>	<i>d.</i>																									
9	12	6 $\frac{1}{4}$																									
		4																									
<hr style="width: 100%;"/>																											
5)	38	10 $2$																									
	<hr style="width: 100%;"/>																										
	£7	14 $0\frac{1}{2}$																									
		<hr style="width: 100%;"/>																									

No.

ANSWERS.

				£	s.	d.
106.	10s. 0d. = $\frac{1}{2}$	7426 $\frac{2}{3}$ 6	at	6	15	8 2
		44556 0 0		6)	18	11 4
	5s. 0d. = $\frac{1}{4}$	3713 0 0				
	6d. = $\frac{1}{10}$	1856 10 0		£2	5	2 $\frac{1}{2}$
	2d. = $\frac{1}{5}$	185 13 0				
		61 17 8				
	$\frac{2}{3}$ =	2 5 2 $\frac{1}{2}$				
		£50875 5 10 $\frac{1}{2}$				

				£	s.	d.
107.	10s. 0d. = $\frac{1}{2}$	3278 $\frac{1}{2}$ 2	at	2	12	6 3
		6556 0 0		5)	7	17 6
	2s. 6d. = $\frac{1}{4}$	1639 0 0				
		409 15 0		£1	11	6
	$\frac{3}{5}$ =	1 11 6				
		£8606 6 6				

				s.	d.
108.	10s. 0d. = $\frac{1}{2}$ } 4s. 0d. = $\frac{1}{3}$ }	4625 $\frac{1}{2}$	at	14	7 $\frac{1}{2}$ 3
		2312 10 0			
	6d. = $\frac{1}{8}$	925 0 0		7)	29 3
	1 $\frac{1}{2}$ d. = $\frac{1}{4}$	115 12 6			
		28 18 1 $\frac{1}{2}$		4	2
	$\frac{2}{7}$ =	0 4 2			
		£3382 4 9 $\frac{1}{2}$			

## ANSWERS.

$10s. 0d. = \frac{1}{2}$	} 2010 $\frac{3}{8}$	at	$\pounds$	<i>s.</i>	<i>d.</i>
$6s. 8d. = \frac{1}{3}$			6	16	9
	6				8
	<hr/>		<hr/>		
	12080	0 0	5)	20	10 8
	1005	0 0	<hr/>		
$1d. = \frac{1}{80}$	670	0 0	$\pounds$	4	2 0 $\frac{1}{2}$
	8	7 6	<hr/>		
$\frac{3}{5} =$	4	2 0 $\frac{1}{2}$	<hr/>		
	<hr/>		<hr/>		
	$\pounds$	13747 9 6 $\frac{1}{2}$	<hr/>		

$10s. 0d. = \frac{1}{2}$	} 3607 $\frac{1}{8}$	at	$\pounds$	<i>s.</i>	<i>d.</i>
$4s. 0d. = \frac{1}{5}$			8)	8	19 8 $\frac{1}{2}$
	8		<hr/>		
	<hr/>		<hr/>		
	28856	0 0	$\pounds$	1	2 5 $\frac{1}{2}$
$5s. 0d. = \frac{1}{2}$	1803	10 0	<hr/>		
	901	15 0	<hr/>		
$8d. = \frac{1}{8}$	721	8 0	<hr/>		
$\frac{1}{2}d. = \frac{1}{16}$	120	4 8	<hr/>		
	7	10 3 $\frac{1}{2}$	<hr/>		
$\frac{1}{8} =$	1	2 5 $\frac{1}{2}$	<hr/>		
	<hr/>		<hr/>		
	$\pounds$	32411 10 5	<hr/>		

$10s. 0d. = \frac{1}{2}$	} 1243 $\frac{3}{4}$	at	$\pounds$	<i>s.</i>	<i>d.</i>
			3	17	7
					2
	<hr/>		<hr/>		
	8729	0 0	9)	7	15 2
$5s. 0d. = \frac{1}{2}$	621	10 0	<hr/>		
$2s. 6d. = \frac{1}{3}$	310	15 0	<hr/>		
$1d. = \frac{1}{30}$	155	7 6	$\pounds$	0	17 2 $\frac{3}{4}$
	5	8 7	<hr/>		
$\frac{5}{9} =$	0	17 2 $\frac{3}{4}$	<hr/>		
	<hr/>		<hr/>		
	$\pounds$	4822 13 3 $\frac{3}{4}$	<hr/>		



No.	ANSWERS.		
	£	s.	d.
112	1	10	5
			3
	<hr/>		
	£4	11	3
	<hr/>		

	£	s.	d.
113	1	10	5
			7
	<hr/>		
	£10	12	11
	<hr/>		

	£	s.	d.
114.	1	10	5
			9
	<hr/>		
	£13	13	9
	<hr/>		

No.	ANSWERS.		
	£	s.	d.
115.	1	10	5
			14
	<hr/>		
	£21	5	10
	<hr/>		

	£	s.	d.
116.	1	10	5
			27
	<hr/>		
	£41	1	3
	<hr/>		

	£	s.	d.
117.	1	10	5
			8
	<hr/>		
	12	3	4
		15	2½
	<hr/>		
	£12	18	6½
	<hr/>		

## BILLS OF PARCELS.

No.	ANSWERS.					
(1)	s.	d.	£	s.	d.	
15 @	13	6 =	10	2	6	
24 @	18	9 =	22	10	0	
27 @	8	4 =	11	5	0	
16 @	6	3 =	5	0	0	
12 @	2	10 =	1	14	0	
32 @	1	8 =	2	13	4	
	<hr/>					
	£53					4 10
	<hr/>					

No.	ANSWERS.					
(2)	s.	d.	£	s.	d.	
9 @	4	6 =	2	0	6	
6 @	15	9 =	4	14	6	
17 @	5	4 =	4	10	8	
23 @	4	10 =	5	11	2	
14 @	2	4 =	1	12	8	
18 @	4	2 =	3	15	0	
19 @	1	7½ =	1	10	10	
	<hr/>					
	£23					15 4
	<hr/>					

No.	ANSWERS.					
(3)	s.	d.	£	s.	d.	
40 @	1	6	=	3	0	0
34 @	1	4½	=	2	6	9
31 @	5	8	=	8	15	8
29 @	2	4	=	3	7	8
17½ @	7	2½	=	6	6	1½
13½ @	10	6	=	7	4	4½
54 @	1	2½	=	3	5	3
						<u>£34 5 10½</u>

(4)	s.	d.	£	s.	d.	
9½ @	12	9	=	6	1	1½
13 @	15	6	=	10	1	6
11½ @	6	10	=	4	0	3½
14 @	11	3	=	7	17	6
12½ @	10	8	=	6	10	8
11½ @	18	0	=	10	4	9
						<u>£44 15 10</u>

No.	ANSWERS.					
(5)	s.	d.	£	s.	d.	
252 @ 6	4	=	79	16	0	
252 @ 6	8	=	84	0	0	
252 @ 8	0	=	100	16	0	
						<hr/>
						£264 12 0
						<hr/>

(6)	d.	£	s.	d.		
15½ @ 4	=	0	5	2		
17¼ @ 5½	=	0	7	10¾		
19¾ @ 6	=	0	9	10½		
17 @ 3	=	0	4	3		
8½ @ 18	=	0	12	4½		
32½ @ 8½	=	1	3	0½		
13 @ 9	=	0	9	9		
						<hr/>
						£3 12 4
						<hr/>

## TARE AND TRET.

No.	ANSWER.					
(1)	cwt. qr. lb.			cwt. qr. lb.		
	5	2	19	0	0	18
		9			9	
	51	0	3	1	1	22
	1	1	22			
	gross			tare		
	19	2	9			
	net.					

No.	ANSWER.					
(2)	cwt. qr. lb.			cwt. qr. lb.		
	1	3	9	0	0	18
		6			6	
	10	3	26	0	3	24
	0	3	24			
	gross			tare		
	10	0	2			
	net.					

No.	ANSWER.		
	cwt.	qr.	lb.
(3)	6	3	14
			7
<hr/>			
8 lbs. = $\frac{1}{14}$	48	0	14 gross
<hr/>			
4 = $\frac{1}{2}$	3	1	20
	1	2	24
<hr/>			
	5	0	16 tare
<hr/>			
	42	3	26 net.
<hr/> <hr/>			

No.	ANSWERS.		
	cwt.	qr.	
(4)	3	2	
		8	
<hr/>			
16 lbs. = $\frac{1}{7}$	28	0	gross
<hr/>			
2 = $\frac{1}{3}$	4	0	
	0	2	
<hr/>			
	4	2	tare
<hr/>			
	23	2	net
<hr/> <hr/>			

(5)	cwt.	qr.	lb.
14 lbs. = $\frac{1}{8}$	202	2	12 gro
<hr/>			
1 = $\frac{1}{14}$	25	1	8 $\frac{1}{2}$
	1	3	6 $\frac{1}{2}$
<hr/>			
	27	0	15 tare
<hr/>			
	175	1	25 net
<hr/> <hr/>			

No. ANSWER.

(6)	cwt.	qr.	lb.
	5	2	12
			9
<hr/>			
	50	1	24
	7	2	24 tare
<hr/>			
26)	42	3	0
	1	2	16 tret
<hr/>			
	41	0	12 net.
<hr/> <hr/>			

	lb.
	96
	9
<hr/>	
28 {	(4) 864
	---
	(7) 216
<hr/>	
4)	30 24
<hr/>	
	7 2 24
<hr/> <hr/>	

No.

## ANSWERS.

cwt. qr. lb.			lb.	
1 3 9			18	
6			6	
<hr/>			<hr/>	
10	3	26 gross	28 {	4) 108
3	24	tare		<hr/>
<hr/>			7) 27	<hr/>
26)	10	0 2	<hr/>	
		1 15	3 24	
		<hr/>	<hr/>	
	9	2 15 net	<hr/>	
		<hr/>	<hr/>	

(8)

cwt. qr. lb.			cwt. qr. lb.		
67	2	18 gross	0	1	12
8	2	8 tare			2
<hr/>			<hr/>		
26)	59	0 10	0	2	24
	2	1 2½ tret			12
		<hr/>			<hr/>
	56	3 7½ net	8	2	8
		<hr/>			<hr/>

No.

## ANSWERS.

(9)

	cwt.	qr.	lb.	
	6	3	14	
			8	
8 lbs. = $\frac{1}{14}$	55	0	0	gross
4 = $\frac{1}{2}$	3	3	20	}
	1	3	24	
	5	3	16	tare
26)	49	0	12	tare suttle
	1	3	15 $\frac{1}{2}$	tret
168)	47	0	24 $\frac{1}{2}$	tret suttle
or 47 $\times$ 2 $\div$ 3	0	1	3	cloff
	46	3	21 $\frac{1}{2}$	net

(10)

	cwt.	qr.	lb.	
	3	2	0	
			8	
16 lbs. = $\frac{1}{7}$	28	0	0	gross
2 = $\frac{1}{8}$	4	0	0	}
	0	2	0	
	4	2	0	tare
26)	23	2	0	tare suttle
	0	3	17	tret
168)	22	2	11	tret suttle
			15	cloff
	22	1	24	net

## ANSWERS.

	cwt.	qr.	lb.	
14 lbs. = $\frac{1}{8}$	202	2	12	
1 = $\frac{1}{14}$	25	1	$8\frac{1}{2}$	
	1	3	$6\frac{1}{2}$	
	27	0	15	tare
26)	175	1	25	tare suttie
	6	2	$26\frac{1}{4}$	tret
168)	168	2	$26\frac{1}{4}$	tret suttie
	1	0	$0\frac{1}{2}$	cloff
	167	2	$25\frac{1}{4}$	net

	cwt.	qr.	lb.	
2 qrs. 18 lbs. $\times 24 =$	47	2	18	
	15	3	12	tare
26)	31	3	6	tare suttie
	1	0	25	tret
	30	2	9	net

## SIMPLE INTEREST.

## ANSWERS.

$$65\% \times 5 \div 100 = 13\% \text{ } 7s. \text{ interest for 1 year } \times 4 = 8s.$$

$$64\% \text{ } 15s. \times 4 \div 100 = 38\% \text{ } 11s. \text{ } 9\frac{1}{2}d. \text{ interest for 1 } \times 6 = 231\% \text{ } 10s. \text{ } 9d.$$

$$368\% \text{ } 10s. \times 4\frac{1}{2} \div 100 = 106\% \text{ } 11s. \text{ } 7\frac{3}{4}d. \text{ interest for } \text{var} \times 4\frac{1}{2} = 479\% \text{ } 12s. \text{ } 4\frac{3}{4}d.$$



No.		ANSWERS.		
		£	s.	d.
(8)	$\frac{1}{3}$	7462	13	0
				$3\frac{1}{2}$

22387	19	0
3781	6	6

100)	26119	5	6
------	-------	---	---

4 weeks = $\frac{1}{3}$	261	3	$10\frac{1}{2}$
			9

2 weeks = $\frac{1}{3}$	2350	14	$8\frac{1}{2}$
	20	1	10
	10	0	11

£2380	17	$5\frac{1}{2}$
-------	----	----------------

(9)

£	s.	d.
9864	17	9
		$4\frac{3}{8}$

3	99459	11	0
8 =	3699	6	$7\frac{1}{2}$

100)	43158	17	$7\frac{1}{2}$
------	-------	----	----------------

4 weeks = $\frac{1}{3}$	431	11	$9\frac{1}{2}$
			10

4315	17	$8\frac{1}{2}$
33	3	$11\frac{3}{4}$

2 weeks = $\frac{1}{3}$	16	11	$11\frac{3}{4}$
1 week = $\frac{1}{3}$	8	5	$11\frac{3}{4}$
4 days = $\frac{1}{7}$	4	14	$10\frac{1}{2}$

Int. for 10 yrs. 7 } wks. and 4 days }	4378	14	6
Principal	9864	17	6

Amount	£14243	12	3
--------	--------	----	---



No.

ANSWERS.

(10)

	£	s	d.
	460	12	6
			5
	<hr/>		
100)	2303	2	6
	<hr/>		
4 months = $\frac{1}{3}$	23	0	$7\frac{1}{2}$
			2
	<hr/>		
	46	1	3
	7	13	$6\frac{1}{2}$
	<hr/>		
	£53	14	$9\frac{1}{2}$
	<hr/> <hr/>		

(11)

	£	s.	d.
	723	15	6
			$4\frac{3}{4}$
	<hr/>		
$\frac{2}{1} =$	2895	2	0
	542	16	$7\frac{1}{2}$
	<hr/>		
100)	3437	18	$7\frac{1}{2}$
	<hr/>		
	34	7	7
			$3\frac{1}{2}$
	<hr/>		
	103	2	9
	17	3	$9\frac{1}{2}$
	<hr/>		
	£120	6	$6\frac{1}{2}$
	<hr/> <hr/>		

No.	ANSWER.
	£ s. d.
(12)	246 15 0
	2½
	498 10 0
	123 7 6
	100) 616 17 6
4 weeks = 1/13	6 3 4½
	3
	18 10 1½
2 weeks = 1/6	0 9 5¾
4 days = 1/7	0 4 8¾
	0 1 4½
Int. for 3 yrs. 6 } wks. and 4 dys. }	19 5 8¼
Principal	246 15 0
Amount	£266 0 8½

COMPOUND INTEREST.

No.	ANSWER.
	£ s. d.
(1) 5 = 1/20	420 0 0
	21 0 0
	441 0 0
1/20	22 1 0
	463 1 0
1/20	23 3 0½
	486 4 0½ amount in 3 yrs.
	420 0 0 principal
	£ 66 4 0½ interest for 3 yrs.

No.

ANSWERS.

	£	s.	d.		£	s.
(2)	640	0	0	$\times 3 \div 100 =$	19	4
Interest for 1 year	19	4	0			
	659	4	0	$\times 3 \div 100 =$	19	15
Do. 2 years	19	15	6			
	678	19	6	$\times 3 \div 100 =$	20	7
Do. 3 „	20	7	$4\frac{1}{2}$			
	699	6	$10\frac{1}{2}$	$\times 3 \div 100 =$	20	19
Do. 4 „	20	19	$7\frac{1}{4}$			
	£720	6	$5\frac{1}{4}$	amount.		

	£	s.	d.		£	s.
(3)	678	16	0	$\times 3\frac{1}{2} \div 100 =$	23	15
Interest for 1 year	23	15	$1\frac{3}{4}$			
	702	11	$1\frac{3}{4}$	$\times 3\frac{1}{2} \div 100 =$	24	11
Do. 2 years	24	11	$9\frac{1}{4}$			
	727	2	11	$\times 3\frac{1}{2} \div 100 =$	25	9
Do. 3 „	25	9	0			
	752	11	11	$\times 3\frac{1}{2} \div 100 =$	26	6
Do. 4 „	26	6	$9\frac{3}{4}$			
	778	18	$8\frac{3}{4}$	$\times 3\frac{1}{2} \div 100 =$	27	5
Do. 5 „	27	5	3			
	806	3	$11\frac{1}{4}$	$\times 3\frac{1}{2} \div 100 =$	28	4
Do. 6 „	28	4	4			
	834	8	$3\frac{1}{4}$	amount		
	678	16	0	principal		
	£155	12	$3\frac{1}{4}$	compd. interest for 6 yrs		

## DISCOUNT.

83

## ANSWER.

		£	s.	d.		£	s.	d.
		786	10	0	$\times 4\frac{1}{2} \div 100 =$	35	7	10
Interest for 1 year		35	7	10				
		821	17	10	$\times 4\frac{1}{2} \div 100 =$	36	19	8 $\frac{1}{4}$
Do.	2 years	36	19	8 $\frac{1}{4}$				
		858	17	6 $\frac{1}{4}$	$\times 4\frac{1}{2} \div 100 =$	38	12	11 $\frac{3}{4}$
Do.	3 „	38	12	11 $\frac{3}{4}$				
		897	10	6	$\times 4\frac{1}{2} \div 100 =$	40	7	9 $\frac{1}{4}$
Do.	4 „	40	7	9 $\frac{1}{4}$				
		937	18	3 $\frac{1}{4}$	$\times 4\frac{1}{2} \div 100 =$	42	4	1 $\frac{1}{4}$
Do.	5 „	42	4	1 $\frac{1}{4}$				
		980	2	4 $\frac{1}{2}$	$\times 4\frac{1}{2} \div 100 =$	44	2	1 $\frac{1}{4}$
Do.	6 „	44	2	1 $\frac{1}{4}$				
		1024	4	5 $\frac{3}{4}$	amount			
		786	10	0	principal			
		£237	14	5 $\frac{1}{4}$	compd. interest for 6 yrs.			

## DISCOUNT.

## ANSWER.

$$100\text{L.} + 10 = 110\text{L.} : 640\text{L.} :: 10\text{L.} : ?$$

$$640 \times 10 \div 110 = \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 58 \quad 3 \quad 7\frac{1}{2} \\ 640 \quad 0 \quad 0 \end{array} \text{ discount}$$

$$\underline{\underline{\text{£581 } 16 \quad 4\frac{1}{2}}} \left\{ \begin{array}{l} \text{present} \\ \text{worth.} \end{array} \right.$$

No.

ANSWERS.

(2)

£	s.	d.	£	s.	d.
100	0	0	1	4	7½
1	4	7½			

---

£101 4 7½ : 370 :: 1 4 7½ : ?

---

£	s.	d.
101	4	7½
1	4	7½

101 4 7½ = 97183 farthings.  
 1 4 7½ = 1183 „

1183 × 370 ÷ 97183 = £4 10s. 0½d.  $\frac{79491}{971834}$

(3) March 6th to June 23rd inclusive, 90 days.

90 × 3¾ ÷ 365 =

£	s.	d.
0	18	5¾
100	0	0

---

100 18 5¾

---

£	s.	d.	£	s.	£	s.	d.				
100	18	5¾	:	246	16	:	0	18	5¾	:	?

£	s.	d.
100	18	5¾
0	18	5¾
246	16	0

100 18 5¾ = 96887 farthings.  
 0 18 5¾ = 887 „  
 246 16 0 = 4936 shillings.

4936 × 887 ÷ 96887 = 2l. 5s. 2½d.  $\frac{7233}{96887}$

## COMMISSION, BROKERAGE, &amp;c.

No.

ANSWER.

(1)

£	s.	d.
1243	19	0

---

100) 621 19 6

---

£	s.	d.
6	4	4½

---

No.

ANSWER.

(2)

£	s.	d.
3964	14	0
1982	7	0

---

100) 59,47 1 0

---

£	s.	d.
59	9	4½

---

ANSWERS.

£	s.	d.
467	0	0
		2

3) 934	0	0
--------	---	---

100) 311	6	8
----------	---	---

£ 3	2	3
-----	---	---

£	s.	d.
7648	0	0
		3

8) 22944	0	0
----------	---	---

100) 2868	0	0
-----------	---	---

£ 28	13	7
------	----	---

£	s.	d.
$\frac{1}{4}$ ) 7684	0	0
		$2\frac{1}{4}$

15368	0	0
-------	---	---

1921	0	0
------	---	---

10) 17289	0	0
-----------	---	---

£ 172	17	$9\frac{1}{2}$
-------	----	----------------

No.

ANSWERS.

(6)	£	s.	d.
$\frac{1}{4}$ ) 6968	0	0	$4\frac{1}{4}$

27872	0	0
-------	---	---

1742	0	0
------	---	---

29614	0	0
-------	---	---

		2
--	--	---

100) 592,28	0	0
-------------	---	---

£ 592	5	7
-------	---	---

(7)

£	s.	d.
2450	0	0
4768	0	0

10s. = $\frac{1}{2}$ ) 7218	0	0
		3

21654	0	0
-------	---	---

5s. = $\frac{1}{2}$ ) 3609	0	0
	1804	10
		0

100) 270,67	10	6
-------------	----	---

£ 270	13	6
-------	----	---

(8)

$\frac{1}{2}$	£	s.	d.
	768	0	0
			$4\frac{1}{2}$

3072	0	0
------	---	---

384	0	0
-----	---	---

100) 3456	0	0
-----------	---	---

84	11	$2\frac{1}{4}$
----	----	----------------

768	0	0
-----	---	---

£ 802	11	$2\frac{1}{4}$
-------	----	----------------

## PROMISCUOUS EXERCISES.

No.

ANSWERS.

(1)

umb.	umb.	guin.	skill.	
120	: 70	:: 20	: ?	$420 \times 70 \div 120 = 245$ sl
				or 12l. 5s.

(2)

sec.	sec.	mile	fur.	yds.	
8	: 60	:: 1	5	140	: ?
				3000	

$$3000 \times 60 = 18000$$

	miles.	fur.	yds.
8 = 22500 yards,	or 12	6	60.

(3)

s.	d.	£	£	s.	d.
18	1½	: 15	:: 1	4	2 : ?
£	s.	d.			
0	18	1½	= 435	halfpence.	
1	4	2	= 580	"	
580	× 15	÷ 435	= 20l.		

lb.	oz.	lb.	oz.	days.	lb.	oz.
(4)	1	4	: 2	10	:: 35	: ?
					1	4 = 20 oz.
					2	10 = 42 "
					35	× 42 ÷ 20 = 73½ days.

	gals.	qts.	pt.	gals.	qt.	pt.	£
(5)	112	2	1	: 99	1	1	:: 102 : ?
	112 gals., &c. = 901 pints.						
	99 " &c. = 795 "						
	795 × 102 ÷ 901 = 90l.						

	£	s.	d.	£	s.	d.
(6)	1	: 12	6	:: 641	18	4 : ?
	1l. = 240 pence.					
	12s. 6d. = 150 pence.					

$$£641 \ 18 \ 4 = 154060 \times 150 \div 240 = 401 \ 3 \ 11$$





No.

ANSWERS.

$$(11) \quad \begin{array}{r} s. \quad d. \\ 2 \quad 6 = \frac{1}{8} 273 \frac{1}{4} @ 2 \quad 6 \end{array}$$

$$\begin{array}{r} s. \quad d. \quad 34 \quad 2 \quad 6 \\ \frac{1}{4} \text{ of } 2 \quad 6 \quad 0 \quad 0 \quad 7\frac{1}{2} \\ \hline \pounds 34 \quad 8 \quad 1\frac{1}{2} \end{array}$$

$$(12) \quad \begin{array}{r} 590\frac{3}{4} @ 14s. \\ 7 \end{array}$$

$$\begin{array}{r} 371 \quad 0 \quad 0 \\ \frac{3}{4} \text{ of } 14s. = \quad 0 \quad 10 \quad 6 \\ \hline \pounds 371 \quad 10 \quad 6 \end{array}$$

$$(13) \quad \begin{array}{r} s. \quad d. \quad \pounds \quad s. \quad d. \\ 10 \quad 0 = \frac{1}{2} 762 \frac{3}{5} @ 1 \quad 12 \quad 6 \\ 2 \quad 6 = \frac{1}{4} 381 \quad 0 \quad 0 \\ \frac{3}{5} \quad 95 \quad 5 \quad 0 \\ \quad \quad 0 \quad 19 \quad 6 \\ \hline \pounds 1239 \quad 4 \quad 6 \end{array}$$

$$(14) \quad \begin{array}{r} s. \quad d. \quad s. \quad s. \quad d. \quad \pounds \quad \pounds \quad \pounds \quad \pounds \\ 7 \quad 6 = 5 + 2 \quad 6 = \frac{1}{4} + \frac{1}{8} = \frac{1}{4} + \frac{1}{4} \div 2 \\ \pounds \quad s. \quad d. \\ 4) 147 \quad 14 \quad 7 \\ \hline 2) 36 \quad 18 \quad 7\frac{3}{4} \\ \hline 18 \quad 9 \quad 3\frac{3}{4} \\ \hline \pounds 55 \quad 7 \quad 11\frac{1}{2} \end{array}$$

ANSWERS.

$$\begin{array}{r}
 \text{5) } \begin{array}{r} \text{cwt. qr. lb.} \\ 2 \ 0 \ 13 \times 9 \\ 10 \\ \hline 21 \ 0 \ 18 \\ 19 \ 0 \ 5 \\ \hline 40 \ 0 \ 23 \text{ gross} \\ 19 \times 14 \text{ lbs.} = 2 \ 1 \ 14 \text{ tare} \\ \hline 26) 37 \ 3 \ 9 \text{ tare} \text{ suttle} \\ 1 \ 1 \ 23 \text{ tret} \\ \hline 36 \ 1 \ 14 \text{ net} \\ \hline \hline \end{array}
 \end{array}$$

$$\begin{array}{r}
 \text{3) } \begin{array}{r} \text{cwt. qr. lb.} \\ 4 \ 2 \ 12 \\ 3 \\ \hline 7 \text{ lbs.} = 16) 13 \ 3 \ 8 \text{ gross} \\ 0 \ 3 \ 12\frac{1}{2} \text{ tare} \\ \hline 26) 12 \ 3 \ 23\frac{1}{2} \text{ tare sut.} \\ 0 \ 1 \ 27\frac{1}{2} \text{ tret} \\ \hline 12 \ 1 \ 24 \text{ tret sut.} \\ 3 \times 2 \text{ lbs.} = 6 \text{ cloff} \\ \hline 10\text{s. } 0\text{d.} = \frac{1}{2} 12 \ 1 \ 18 \text{ net} \\ \text{£ } 7 \\ \hline \hline 84 \ 0 \ 0 \\ 6 \ 0 \ 0 \\ 6\text{d.} = \frac{1}{20} 0 \ 6 \ 0 \\ 1 \text{ qr.} = \frac{1}{4} \text{ cwt.} 1 \ 17 \ 7\frac{1}{2} \\ 14 \text{ lbs.} = \frac{1}{2} 0 \ 18 \ 9\frac{3}{4} \\ 4 \text{ lbs.} = \frac{1}{4} 0 \ 5 \ 4\frac{1}{2} \\ \hline \text{£ } 93 \ 7 \ 9\frac{1}{2} \\ \hline \hline \end{array}
 \end{array}$$

No.

ANSWERS.

(17)

	cwt.	qr.	lb.		
No. 1 =	4	2	15	Tare = 1	
„ 2 =	4	2	0	„ = 1	
„ 3 =	3	3	21	„ = 1	
„ 4 =	3	3	14	„ = 1	
„ 5 =	4	0	14	„ = 1	
	21	0	8	1cwt. 1qr.	
Tare 1	1	1	0		
	19	3	8	or 138 stone 12 lbs.	
st.	st.	lb.	lb.	st.	lb.
20 : 138	12	:	:	8 : 55½	or 3 7½.
	st.	lb.			
	138	12			
Tret	3	7½			
	195	4½			
s.	d.	£	£		
11	6	= ½	+ ½	+ ¼	
st.	lb.	st.	st.	st.	
135	4½	= 135	+ ¼	+ ¼ ÷ 8	
£	£	£	£	s.	d.
135	+ ¼	+ ¼ ÷ 8	= 135	5	7½
	£	s.	d.		
2)	135	5	7½		
10)	67	12	9¾	= ½	
2)	6	15	3¼	= ½	
	3	7	7½	= ¼	
	£77	15	8½		

(18)

£	s.	d.		£	s.	d.
344	17	6	× 6 ÷ 100 =	20	13	10½

No.

ANSWERS.

19)

$$\begin{aligned} & \text{£} \quad \text{s.} \quad \text{d.} \quad \text{£} \quad \text{£} \quad \text{£} \quad \text{£} \\ & 5 \quad 14 \quad 6 = 5 + \frac{1}{2} + \frac{1}{2} \div 5 + \frac{1}{2} \div 5 + \frac{\text{£} 1}{2 \times 5} \div \\ & 1 = \frac{\text{£} 100}{20} + \frac{\text{£} 100}{20} \div 10 + \frac{\text{£} 100}{20 \times 10} \div 5 + \frac{\text{£} 100}{20 \times 10} \div \\ & 5 + \frac{\text{£} 100}{20 \times 10 \times 5} \div 4: \text{ or thus— } 968\frac{1}{2}. 5 \times 5 \div 100 \\ & = 48 \quad 8 \quad 3 \text{ interest at 5 per cent. for one year.} \end{aligned}$$

$$\begin{array}{rcl} 10\text{s. } 0\text{d.} & = & \frac{1}{10} \\ 2\text{s. } 6\text{d.} & = & \frac{1}{4} \\ 2\text{s. } 0\text{d.} & = & \frac{1}{5} \end{array}$$

$$\begin{array}{rcl} \text{£} & \text{s.} & \text{d.} \\ 48 & 8 & 3 \\ 4 & 16 & 10 \\ 1 & 4 & 2\frac{1}{2} \\ 0 & 19 & 4\frac{1}{2} \end{array}$$

£55 8 8 interest at the given rate.

20)

$$\begin{array}{r} \text{£} \quad \text{s.} \\ 20) 1090 \quad 0 \end{array}$$

$$\begin{array}{rcl} \text{£} & \text{s.} & \\ 12) 65 & 8 & \\ \hline 5 & 9 & \times 5 = \\ \hline \end{array} \quad \begin{array}{rcl} 5) & 54 & 10 \\ & 10 & 18 \\ & 65 & 8 \\ & 27 & 5 \\ \hline & \text{£}92 & 13 \\ \hline \end{array} \quad \begin{array}{l} \text{interest at 5 per cent.} \\ \text{" at 1 per cent.} \\ \text{" for 1 year.} \\ \text{" for 5 months.} \\ \text{" for the given} \\ \text{time.} \end{array}$$

No.

ANSWERS.

(21)

£ s. d.

40) 279 11 0

4) 6 19 9 $\frac{1}{4}$  interest for 6 months.  
 1 14 11 $\frac{1}{4}$  „ for 1 $\frac{1}{2}$  months.

5) 8 14 8 $\frac{1}{2}$  „ at 5 per cent.  
 1 14 11 $\frac{1}{4}$  „ at 1 per cent.

£6 19 9 $\frac{1}{4}$  „ at the given rate.

(22) 250 - 80 = 170. 170 - 70 = 100.

£ £  
 250 × 9 = 2250  
 170 × 6 = 1020  
 100 × 9 = 900

12) 4170 for 1 month.

20) 347 10 0 for 1 year.

2) 17 7 6 at 5 per cent. interest.  
 5) 8 13 9 at 2 $\frac{1}{2}$  „ „  
 1 14 9 at  $\frac{1}{2}$  „ „

27 16 0 interest.  
 100 0 0 principal.

£127 16 0

No.

ANSWERS.

(23)  $300 - 60 = 240.$   $240 - 100 = 140.$   
 $140 - 75 = 65$

£	£
$300 \times 3 = 900$	
$240 \times 4 = 960$	
$140 \times 5 = 700$	
$65 \times 6 = 390$	

12)2950 for 1 month.

20)245 16 8 for 1 year.

5)12	5	10	at 5 per cent. interest.
2	9	2	at 1       "       "
<hr/>			
14	15	0	interest.
65	0	0	principal.

£79 15 0

(24)

1.60471*l.* is the amount of *1l.* for the given time and rate.  
 142.0 is the multiplier.

	£	s.	d.
$1\ 60471 \times 142.0 = 227.86882 =$	227	17	$4\frac{1}{2}$
the required amount: from which deduct	142	0	0

The required interest   £ 85 17  $4\frac{1}{2}$

(25)

2*l.* 1*s.*  $9\frac{1}{4}$ *d.* is the interest of 100*l.* at 6 per cent. for 127 days.

$\frac{102*l.* 1*s.* 9\frac{1}{4}$ *d.* : 100*l.* :: 200*l.* : ?    $200 \times 100 \div$   
 $98005*f.*$   
 $98005 = 195*l.* 18*s.*  $2\frac{1}{2}$ *d.*$

(26)

4*l.* 16*s.*  $7\frac{1}{4}$ *d.* is the interest of 100*l.* at 6 per cent. for 294 days.

£	s.	d.	£	£	s.	d.
104	16	$7\frac{1}{4}$	:	100	:	$35\ 13\ 8 : ?$
<hr/>						<hr/>
100639 <i>f.</i>						33776 <i>f.</i>
$33776 \times 100 \div 100639 = 34l. 0s. 9\frac{1}{4}d.$						

No.

## ANSWERS.

(27)      £                      s.                      £                      s.                      d.                      £                      s.                      d.  
100    :    5    : :    971   14   7 : ?                      971   14   7

$$5s. \div 100 = 2l. 8s. 7d.$$

(28)    £                 £                 £  
95 : 100 :: 900 : ?      900 × 100 ÷ 95  
                        947*l.* 7*s.* 4½*d.*

### SECTION 3.

## VULGAR FRACTIONS.

### GREATEST COMMON MEASURE.

No.

## ANSWERS.

(1)

126)144(1  
126

18)126(7      G.C.M. 18  
126                

(2)

8444)3556(1  
3444

112)3444(30  
3360

$$84)112(1$$
$$\begin{array}{r} 28)84(3 \\ \underline{84} \end{array}$$

**G.C.M. 28.**

ANSWERS.

$$\begin{array}{r} 13667)14186(1 \\ 13667 \end{array}$$

$$\begin{array}{r} 519)13667(26 \\ 1038 \end{array}$$

$$\begin{array}{r} 3287 \\ 3114 \end{array}$$

$$\begin{array}{r} 173)519(3 \\ 519 \end{array}$$

G.C.M. 173

1)

$$\begin{array}{r} 43365)44688(1 \\ 43365 \end{array}$$

$$\begin{array}{r} 1323)43365(32 \\ 3969 \end{array}$$

$$\begin{array}{r} 3675 \\ 2646 \end{array}$$

$$\begin{array}{r} 1029)1323(1 \\ 1029 \end{array}$$

$$\begin{array}{r} 294)1029(3 \\ 882 \end{array}$$

$$\begin{array}{r} 147)294(2 \\ 294 \end{array}$$

G.C.M. 147



00

SECTION III.

No.

ANSWERS.

(5)

$$\begin{array}{r} 11050)35581(3 \\ 33150 \\ \hline \end{array}$$

$$\begin{array}{r} 2431)11050(4 \\ 9724 \\ \hline \end{array}$$

$$\begin{array}{r} 1326)2431(1 \\ 1326 \\ \hline \end{array}$$

$$\begin{array}{r} 1105)1326(1 \\ 1105 \\ \hline \end{array}$$

G.C.M. 221

$$\begin{array}{r} 221)1105(5 \\ 1105 \\ \hline \end{array}$$

(6)

$$\begin{array}{r} 16)24(1 \\ 16 \\ \hline 8)16(2 \\ 16 \\ \hline \end{array}$$

$$\begin{array}{r} 8)140(17 \\ 8 \\ \hline 60 \\ 56 \\ \hline 4)8(2 \\ 8 \\ \hline \end{array}$$

G.C.M. 4

$$\begin{array}{r} 4)16 \\ 4 \\ \hline 2 \\ \hline \end{array}$$

$$\begin{array}{r} 4)24 \\ 4 \\ \hline 6 \\ \hline \end{array}$$

$$\begin{array}{r} 4)140 \\ 4 \\ \hline 36 \\ \hline \end{array}$$

## LEAST COMMON MULTIPLE OF NUMBERS.

ANSWERS.	No.	ANSWERS.
ie greatest com. measure	(4)	
3)78	The greatest com. measure	8)638296
—	is 8.	—
26		79787
93		33888
—		—
78		638296
234		638296
—		638296
C.M. 2418		239361
—		239361
ie greatest com. measure	L.C.M.	2703821856
72		—
19		
—		
648		
72		
—		
C.M. 1368	(5)	
—	The greatest com. measure	
ie greatest com. measure	is 4.	4)18996
5)464320		—
—		4749
92864		29932
18945		4749
—		—
464320		269388
371456		119728
835776		209524
742912		119728
92864		—
—		
C.M. 1759308480	L.C.M.	142147068
—		—

No.      ANSWERS.

(6)

The greatest com. measure  
is 9.

9)260424

---

28936

54423

---

86808

57872

115744

115744

144680

L.C.M.    1574783928

(7)

The greatest com. measure  
of 18 and 17 is 1.

18

17

---

126

18

---

306The least common multiple  
of 18 and 17 is therefore 306.The greatest com. measure  
of 306 and 43 is 1.

306

43

---

918

1224

---

13158Hence the least common  
multiple of all the given num-  
bers is 13158.

No.      ANSWER.

(8)

The greatest com. meas  
of 19 and 78 is 1.

78

19

---

702

78

---

1482The least common multi-  
of 78 and 19 is theref  
1482.The greatest com. meas  
of 1482 and 84 is 6.

6)1482

---

247

84

---

988

1976

---

20748The least common multi-  
of 1482 and 84 is there  
20748.The greatest com. mea  
of 20748 and 61 is 1.

20748

61

---

20748

124188

---

1265628

ANSWER.

ce, the least common  
le of all the given  
rs is 1265628.

greatest com. measure  
nd 176832 is 3.

3)176832

---

58944  
51

---

58944  
294720

---

3006144

least common multiple  
nd 176832 is therefore  
4.

greatest com. measure  
06144 and 29172 is  
; hence 3006144 is  
ast common multiple.

greatest com. measure  
3144 and 5862 is 6.

6)3006144

---

501024  
5862

---

1002048  
3006144  
4008192  
2505120

---

2937002688

No.

ANSWER.

Hence the least common  
multiple of all the numbers  
is 2937002688.

(10)

The greatest com. measure  
of 537842 and 16819 is 1.

537842  
16819

---

4840578  
537842

---

4302736  
3227052  
537842

---

9045964598

The least common multiple  
of 537842 and 16819 is  
therefore 9045964598.

The greatest com. measure  
of 9045964598 and 4367 is  
11.

11)9045964598

---

822360418  
4367

---

5756522926  
4934162508  
2467081254  
3289441672

---

3591247945406

The least common multiple  
of 9045964598 and 4367 is  
therefore 3591247945406.

## ANSWER.

The greatest common measure of 3591247 ~~2473~~ <sup>15406</sup> and 2473 is 1.

3591247945406  
2473

10773743836218  
25138735617842  
14364991781624  
7182495890812

8881156168989038

Hence the least common multiple of all the given  
bers is 8881156168989038. num

## REDUCTION OF VULGAR FRACTIONS.

No.	ANSWERS.	No.	ANSWERS.
(1)	3)7463 <u>        </u> 2487 $\frac{1}{3}$ <u>        </u>	(4)	698 ) 64237 ( 92 $\frac{21}{8}$ 6282 <u>        </u> 1417 1396 <u>        </u> 21 <u>        </u>
(2)	14 { 2)8463 <u>        </u> 7)4231-1 <u>        </u> 604 $\frac{7}{14} = \frac{1}{2}$ <u>        </u>		
(3)	43 ) 9786 ( 227 $\frac{25}{43}$ 86 <u>        </u> 118 86 <u>        </u> 326 301 <u>        </u> 25 <u>        </u>	(5)	89 ) 8363 ( 93 $\frac{86}{89}$ 801 <u>        </u> 353 267 <u>        </u> 86 <u>        </u>

# VULGAR FRACTIONS.

ANSWERS.	No.	ANSWERS.
$\begin{array}{r} 8586 \text{ ( } 199\frac{1}{3} \text{ )} \\ 43 \\ \hline 428 \\ 387 \\ \hline 416 \\ 387 \\ \hline 29 \\ \hline \end{array}$	(11)	$\begin{array}{r} 487600)492001(1\frac{1}{4} \\ 487600 \\ \hline 4401 \\ \hline \end{array}$
$\begin{array}{r} 7982 \text{ ( } 11\frac{1}{8} \text{ )} \\ 680 \\ \hline 1182 \\ 680 \\ \hline 502 \\ \hline \end{array}$	(12)	$\begin{array}{r} 7036)736201(104\frac{1}{2} \\ 7036 \\ \hline 32601 \\ 28144 \\ \hline 4457 \\ \hline \end{array}$
$\begin{array}{r} 3643 \text{ ( } 1\frac{1}{2} \text{ )} \\ 2104 \\ \hline 1539 \\ \hline \end{array}$	(13)	$\begin{array}{r} 3684)480010(130\frac{1}{2} \\ 3684 \\ \hline 11161 \\ 11052 \\ \hline 1090 \\ \hline \end{array}$
$\begin{array}{r} 742683 \text{ ( } 96\frac{1}{8} \text{ )} \\ 69183 \\ \hline 50853 \\ 46122 \\ \hline 4731 \\ \hline \end{array}$	(14)	$\begin{array}{r} 4968)876246(176\frac{1}{2} \\ 4968 \\ \hline 37944 \\ 34776 \\ \hline 31686 \\ 29808 \\ \hline 1878 \\ \hline \end{array}$
$\begin{array}{r} 968700 \text{ ( } 351 \text{ )} \\ 8280 \\ \hline 14076 \\ 13800 \\ \hline 2760 \\ 2760 \\ \hline \end{array}$	(15)	$\begin{array}{r} 7\frac{1}{2} \\ 2 \\ \hline 15 \\ 2 \\ \hline \end{array}$

No.	ANSWERS.	No.	ANSWERS.
(16)	$\begin{array}{r} 8\frac{1}{3} \\ 3 \\ \hline 26 \\ 3 \end{array}$	(23)	$\begin{array}{r} 842\frac{17}{36} \\ 36 \\ \hline 5059 \\ 2527 \\ \hline 30329 \\ 36 \end{array}$
(17)	$\begin{array}{r} 17\frac{2}{5} \\ 5 \\ \hline 89 \\ 5 \end{array}$	(24)	$\begin{array}{r} 684\frac{17}{27} \\ 27 \\ \hline 4797 \\ 1369 \\ \hline 18487 \\ 27 \end{array}$
(18)	$\begin{array}{r} 19\frac{1}{9} \\ 9 \\ \hline 178 \\ 9 \end{array}$	(25)	$\begin{array}{r} 976\frac{24}{126} \\ 126 \\ \hline 5860 \\ 11714 \\ \hline 123000 \\ 126 \end{array}$
(19)	$\begin{array}{r} 27\frac{1}{7} \\ 7 \\ \hline 193 \\ 7 \end{array}$	(26)	$\begin{array}{r} 843\frac{31}{421} \\ 421 \\ \hline 844 \\ 1689 \\ 3872 \\ \hline 354934 \\ 421 \end{array}$
(20)	$\begin{array}{r} 647\frac{2}{15} \\ 5 \\ \hline 9707 \\ 15 \end{array}$		
(21)	$\begin{array}{r} 360\frac{19}{17} \\ 17 \\ \hline 6130 \\ 17 \end{array}$		
(22)	$\begin{array}{r} 976\frac{1}{30} \\ 30 \\ \hline 29301 \\ 30 \end{array}$		

## ANSWERS.

$$\begin{array}{r} 687 \frac{28}{111} \\ 111 \\ \hline 7585 \\ 687 \\ \hline 76285 \\ 111 \end{array}$$

$$\begin{array}{r} 769 \frac{11}{234} \\ 234 \\ \hline 3077 \\ 2308 \\ 1539 \\ \hline 180057 \\ 234 \end{array}$$

$$\begin{array}{r} 807 \frac{121}{621} \\ 621 \\ \hline 808 \\ 1614 \\ 4843 \\ \hline 501248 \\ 621 \end{array}$$

$$\frac{3}{6} \times \frac{2}{7} \times \frac{5}{7} = \frac{30}{294}$$

$$\frac{7}{9} \times \frac{3}{11} \times \frac{8}{15} = \frac{168}{1485}$$

## No. ANSWERS.

$$(32) \frac{5}{13} \times \frac{17}{3} \times \frac{19}{21} = \frac{1615}{819}$$

$$(33) \frac{4}{9} \times \frac{8}{11} \times \frac{11}{12} = \frac{352}{1113}$$

$$(34) \frac{7}{17} \times \frac{8}{19} \times \frac{7}{1} = \frac{392}{323}$$

$$(35) \frac{17}{23} \times \frac{8}{9} \times \frac{3}{25} \times \frac{13}{19} = \frac{33048}{98325}$$

$$(36) \frac{12}{37} \times \frac{1}{7} \times \frac{18}{33} \times \frac{153}{8} = \frac{33048}{68376}$$

$$(37) \frac{11}{21} \times \frac{17}{56} \times \frac{135}{78} \times \frac{24}{1} = \frac{605880}{58968}$$

$$(38) \frac{3}{7} \times \frac{9}{17} \times \frac{29}{78} \times \frac{32}{1} = \frac{25056}{9282}$$

$$(39) \frac{7}{15} \times \frac{13}{19} \times \frac{21}{39} \times \frac{137}{5} = \frac{261807}{55575}$$



No.      ANSWERS.

$$\begin{array}{r}
 (40) \quad 48 \overline{) 272} \text{ ( 5} \\
 \underline{240} \\
 32 \overline{) 48} \text{ ( 1} \\
 \underline{32} \\
 16 \overline{) 32} \text{ ( 2} \\
 \underline{32} \\
 \hline
 \end{array}$$

$$16 \overline{) \frac{48}{272}} = \frac{3}{17}$$

Or thus—

$$\begin{array}{r}
 2 \quad 2 \quad 4 \\
 48 \quad 24 \quad 12 \\
 \hline
 272 = 136 = 68 = \frac{3}{17}
 \end{array}$$

(41)    46) 116(2

92

24) 46(1

24

22) 24(1

22

2) 22(11

22

$$2 \overline{) \frac{46}{116}} = \frac{23}{58}$$

No.      ANSWERS.

$$\begin{array}{r}
 (42) \quad 176 \overline{) 484} \text{ ( 2} \\
 \underline{352} \\
 132 \overline{) 176} \text{ ( 1} \\
 \underline{132} \\
 44 \overline{) 132} \\
 \underline{132} \\
 \hline
 \end{array}$$

$$44 \overline{) \frac{176}{484}} = \frac{4}{11}$$

(43)    48) 160(3

144

16) 48(3

48

$$16 \overline{) \frac{48}{160}} = \frac{3}{10}$$

ANSWER.

$$\begin{array}{r} 740 \overline{) 8675} (11 \\ 8140 \end{array}$$

$$\begin{array}{r} 535 \overline{) 740} (1 \\ 535 \end{array}$$

$$\begin{array}{r} 205 \overline{) 535} (2 \\ 410 \end{array}$$

$$\begin{array}{r} 125 \overline{) 205} (1 \\ 125 \end{array}$$

$$\begin{array}{r} 80 \overline{) 125} (1 \\ 80 \end{array}$$

$$\begin{array}{r} 45 \overline{) 80} (1 \\ 45 \end{array}$$

$$\begin{array}{r} 35 \overline{) 45} (1 \\ 35 \end{array}$$

$$\begin{array}{r} 10 \overline{) 35} (3 \\ 30 \end{array}$$

$$5) \frac{740}{8675} = \frac{148}{1735}$$

$$\begin{array}{r} 5 \overline{) 10} (2 \\ 10 \\ \hline \end{array}$$

No.

ANSWERS.

(45)

$$\begin{array}{r}
 764 \overline{) 5240} (6 \\
 \underline{4584} \\
 656 \\
 656 \overline{) 764} (1 \\
 \underline{656} \\
 108 \\
 108 \overline{) 656} (6 \\
 \underline{648} \\
 8 \\
 8 \overline{) 108} (13 \\
 \underline{104} \\
 4 \\
 4 \overline{) 8} (2 \\
 \underline{8} \\
 4) \frac{764}{5240} = \frac{191}{1310}
 \end{array}$$

(46)

$$\begin{array}{r}
 644 \overline{) 1728} (2 \\
 \underline{1288} \\
 440 \\
 440 \overline{) 644} (1 \\
 \underline{440} \\
 204 \\
 204 \overline{) 440} (2 \\
 \underline{408} \\
 32 \\
 32 \overline{) 204} (6 \\
 \underline{192} \\
 12 \\
 12 \overline{) 32} (2 \\
 \underline{24} \\
 8 \\
 8 \overline{) 12} (1 \\
 \underline{8} \\
 4 \\
 4) \frac{644}{1728} = \frac{161}{432} \qquad 4) \overline{) 8} (2 \\
 \underline{8}
 \end{array}$$

## ANSWERS.

$$25) 1920 \begin{array}{l} 2 \\ 1650 \end{array}$$

$$\begin{array}{r} 270) 825 \begin{array}{l} 3 \\ 810 \end{array} \end{array}$$

$$15) 270 \begin{array}{l} 18 \\ 15 \end{array}$$

$$\begin{array}{r} 120 \\ 120 \end{array}$$

$$\frac{825}{1920} = \frac{55}{128}$$

$$55) 9900 \begin{array}{l} 180 \\ 55 \end{array}$$

$$\begin{array}{r} 440 \\ 440 \end{array}$$

$$55) \frac{55}{9900} = \frac{1}{180}$$

$$45 \begin{array}{l} 5 \\ 00 \end{array}$$

$$45) 220 \begin{array}{l} 1 \\ 145 \end{array}$$

$$75) 145 \begin{array}{l} 1 \\ 75 \end{array}$$

$$70) 75 \begin{array}{l} 1 \\ 70 \end{array}$$

$$5) 70 \begin{array}{l} 14 \\ 70 \end{array}$$

$$5) \frac{1245}{220} = \frac{249}{44}$$

## No.

## ANSWERS.

$$(50) \quad 1344) 1536 \begin{array}{l} 1 \\ 1344 \end{array}$$

$$192) 1344 \begin{array}{l} 7 \\ 1344 \end{array}$$

$$192) \frac{1344}{1536} = \frac{7}{8}$$

$$(51) \quad 1408) 1664 \begin{array}{l} 1 \\ 1408 \end{array}$$

$$256) 1408 \begin{array}{l} 5 \\ 1280 \end{array}$$

$$128) 256 \begin{array}{l} 2 \\ 256 \end{array}$$

$$128) \frac{1408}{1664} = \frac{11}{13}$$

$$(52) \quad 3 \times 3 \times 7 = 63$$

$$2 \times 4 \times 7 = 56$$

$$4 \times 4 \times 3 = 48$$

$$4 \times 3 \times 7 = 84$$

$$\begin{array}{r} 63 \\ 84 \end{array} \quad \begin{array}{r} 56 \\ 84 \end{array} \quad \begin{array}{r} 48 \\ 84 \end{array}$$

$$(53) \quad 5 \times 8 \times 9 = 360$$

$$7 \times 9 \times 9 = 567$$

$$6 \times 9 \times 8 = 432$$

$$9 \times 8 \times 9 = 648$$

$$\begin{array}{r} 360 \\ 648 \end{array} \quad \begin{array}{r} 567 \\ 648 \end{array} \quad \begin{array}{r} 432 \\ 648 \end{array}$$

No.	ANSWER.	No.	ANSWER.
(54)	$9 \times 13 \times 19 = 2223$	(55)	$13 \times 23 \times 27 = 8073$
	$7 \times 11 \times 19 = 1463$		$11 \times 16 \times 27 = 4752$
	$12 \times 11 \times 13 = 1716$		$18 \times 16 \times 23 = 6024$
	<hr/>		<hr/>
	$11 \times 13 \times 19 = 2717$		$16 \times 23 \times 27 = 9936$
	<hr/>		<hr/>
	$2223 \quad 1463 \quad 1716$		$8073 \quad 4752 \quad 6024$
	$2717 \quad 2717 \quad 2717$		$9936 \quad 9936 \quad 9936$

No.	ANSWERS.
(56)	$17 \times 26 \times 42 \times 17 = 315588$
	$19 \times 24 \times 42 \times 17 = 325584$
	$15 \times 24 \times 26 \times 17 = 159120$
	$13 \times 24 \times 26 \times 42 = 340704$
	<hr/>
	$24 \times 26 \times 42 \times 17 = 445536$
	<hr/>
	$315588 \quad 325584 \quad 159120 \quad 340704$
	$445536 \quad 445536 \quad 445536 \quad 445536$

(57)	$21 \times 39 \times 59 \times 78 = 3769038$
	$18 \times 47 \times 59 \times 78 = 3893292$
	$41 \times 47 \times 39 \times 78 = 5861934$
	$27 \times 47 \times 39 \times 59 = 2919969$
	<hr/>
	$47 \times 39 \times 59 \times 78 = 8435466$
	<hr/>
	$3769038 \quad 3893292 \quad 5861934 \quad 2919969$
	$8435466 \quad 8435466 \quad 8435466 \quad 8435466$

(58)	$71 \times 261 \times 701 \times 813 = 10561057803$
	$39 \times 81 \times 701 \times 813 = 1800355167$
	$410 \times 81 \times 261 \times 813 = 7046929530$
	$75 \times 81 \times 261 \times 701 = 1111488075$
	<hr/>
	$81 \times 261 \times 701 \times 813 = 12048530733$
	<hr/>
	$10561057803 \quad 1800355167 \quad 7046929530 \quad 1111488075$
	$12048530733 \quad 12048530733 \quad 12048530733 \quad 12048530733$

No.	ANSWER.								
(59)	$813 \times 3026 \times 980 \times 721 = 1738284308040$ $710 \times 401 \times 980 \times 721 = 201170391800$ $762 \times 401 \times 3026 \times 721 = 666658671252$ $83 \times 401 \times 3026 \times 980 = 98700070840$								
	<hr/> $401 \times 3026 \times 980 \times 721 = 857382543080$								
	<table> <tr> <td><math>1738284308040</math></td><td><math>201170391800</math></td></tr> <tr> <td><math>857382543080</math></td><td><math>857382543080</math></td></tr> <tr> <td><math>666658671252</math></td><td><math>98700070840</math></td></tr> <tr> <td><math>857382543080</math></td><td><math>857382543080</math></td></tr> </table>	$1738284308040$	$201170391800$	$857382543080$	$857382543080$	$666658671252$	$98700070840$	$857382543080$	$857382543080$
$1738284308040$	$201170391800$								
$857382543080$	$857382543080$								
$666658671252$	$98700070840$								
$857382543080$	$857382543080$								

### REDUCTION OF FRACTIONS FROM ONE DENOMINATION TO ANOTHER.

No.	ANSWERS.	No.	ANSWERS.
(1)	$\frac{3}{7} \times 12 \times 4 \times 20 = \frac{3}{7} \times 960 = 408$	(9)	$\frac{7}{8} \times 16 \times 16 \times 28 \times 4 = \frac{dr. 200704}{8}$
(2)	$\frac{4}{7} \times 20 \times 12 = \frac{690}{7} d.$	(10)	$\frac{4}{5} \times 5\frac{1}{2} \times 40 \times 8 = \frac{4}{8800} \text{ mile.}$
(3)	$\frac{4}{5} \times 21 = \frac{4}{105} \text{ guinea.}$	(11)	$\frac{s. 14}{12} \times \frac{d. 6}{12} = 240d.$
(4)	$\frac{4}{7} \times 12 \times 4 = \frac{192}{7} \text{ farthing.}$		$174d.$
(5)	$\frac{7}{9} \times 4 \times 12 \times 5 = \frac{7}{2160} \text{ cr.}$		$\frac{174}{240} = \frac{29}{40} l.$
(6)	$\frac{3}{10} \times 7 = \frac{3}{70} \text{ weeks.}$	(12)	$\frac{s. 17}{12} \times \frac{d. 4}{12} = 240d.$
(7)	$\frac{7}{9} \times 7 \times 24 = \frac{1176}{9} \text{ hour.}$		$208d.$
(8)	$\frac{4}{5} \times 4 \times 4 = \frac{4}{80} \text{ yard.}$		$\frac{208}{240} = \frac{13}{15} l.$

No.      ANSWERS.

$$(13) \quad \begin{array}{r} s. \quad d. \\ 5 \quad 8\frac{1}{4} \end{array} \quad 1l. = 960f.$$

$$\begin{array}{r} 12 \\ \hline 68 \\ 4 \\ \hline 273f. \end{array}$$

$$\frac{273}{960} = \frac{91}{320} l.$$

$$(14) \quad 17s. 9d. = \frac{213}{1} d.$$

$$(15) \quad 6s. 7\frac{1}{2}d. = \frac{319}{1} \text{ farth.}$$

$$(16) \quad \begin{array}{l} 7 \text{ h. } 21 \text{ m.} = 441 \text{ m.} \\ 1 \text{ day} = 1440 \text{ min.} \\ \frac{441}{1440} = \frac{49}{160} \text{ day.} \end{array}$$

$$(17) \quad \begin{array}{l} 7 \text{ lbs. } 3 \text{ drs.} = \frac{1795}{1} \text{ drs.} \\ 1 \text{ cwt.} = \frac{28672}{1} \end{array}$$

$$(18) \quad \begin{array}{l} \text{cwt.} \quad \text{qr.} \quad \text{lb.} \\ 8 \quad 2 \quad 14 = \frac{15456}{1} \text{ ozs.} \end{array}$$

$$(19) \quad 3 \text{ lbs. } 9 \text{ ozs.} = \frac{900}{1} \text{ dwts}$$

$$(20) \quad \begin{array}{l} 16 \text{ hrs. } 13 \text{ min.} = \frac{973}{1} \text{ day} \\ 1 \text{ day} = 1440 \end{array}$$

No.      ANSWERS.

$$(21) \quad \begin{array}{r} 8l. \\ 20 \end{array}$$

$$7)120$$

$$\underline{\underline{17s. 1\frac{1}{2}d. - \frac{1}{7}d}}$$

$$(22) \quad \begin{array}{r} 5s. \\ 12 \\ \hline 6)60 \end{array}$$

$$\underline{\underline{10d.}}$$

$$(23) \quad \begin{array}{r} 4 \text{ crowns} \\ 5 \end{array}$$

$$5)20$$

$$\underline{\underline{4s.}}$$

$$(24) \quad \begin{array}{r} 9 \text{ days} \\ 24 \end{array}$$

$$11)216$$

$$\underline{\underline{19 \text{ hr. } 38 \text{ m. } 10\frac{1}{11}}}$$

$$(25) \quad \begin{array}{r} 14 \text{ guineas} \\ 21 \end{array}$$

$$23)294$$

$$\underline{\underline{12s. 9\frac{1}{2}d. - \frac{1}{13}d}}$$

ANSWERS.	No.	ANSWERS.
4 yards	(29)	
3	23	
<u>      </u>	4	
9)12	<u>      </u>	
<u>      </u>	27)92	
1 foot 4 inches.	<u>      </u>	
<u>      </u>	3qrs. 11lbs. 6ozs. $8\frac{8}{27}$ drs.	
	<u>      </u>	
13 lbs.		
12		
<u>      </u>		
16)156		
<u>      </u>		
9 ozs. 15 dwts.		
<u>      </u>		
	(30)	
13 lbs.	17 miles	
16	8	
<u>      </u>	<u>      </u>	
16)208	24)136	
<u>      </u>	<u>      </u>	
13 ozs.	5fur. 26per. 3yds. 2ft.	
<u>      </u>	<u>      </u>	

## ADDITION.

ANSWER.	No.	ANSWER.
$\frac{2}{3} + \frac{3}{5} + \frac{4}{9}$	(2)	$\frac{3}{7} + \frac{9}{11} + \frac{12}{13}$
$5 \times 9 = 90$	$3 \times 11 \times 13 = 429$	
$3 \times 9 = 81$	$9 \times 17 \times 13 = 819$	
$3 \times 5 = 60$	$12 \times 7 \times 11 = 924$	
<u>      </u>	<u>      </u>	
$\frac{231}{135} = 1\frac{98}{135}$	$\frac{2172}{1001} = 2\frac{170}{1001}$	
$5 \times 9 = \frac{231}{135}$	$7 \times 11 \times 13 = \frac{1001}{1001}$	



No.

## ANSWERS.

(3)

$$\frac{4}{7} + \frac{11}{16} + \frac{18}{23}$$

$$4 \times 16 \times 23 = 1472$$

$$11 \times 7 \times 23 = 1771$$

$$18 \times 7 \times 16 = 2016$$


---


$$7 \times 16 \times 23 = \frac{5259}{2576} = 2 \frac{107}{2576}$$

(4)

$$\frac{7}{9} + \frac{13}{7} + \frac{14}{19} + \frac{23}{121}$$

$$7 \times 17 \times 19 \times 121 = 273581$$

$$13 \times 9 \times 19 \times 121 = 268983$$

$$14 \times 9 \times 17 \times 121 = 259182$$

$$23 \times 9 \times 17 \times 19 = 66861$$


---


$$9 \times 17 \times 19 \times 121 = \frac{868607}{351747} = 2 \frac{165113}{351747}$$

(5)

$$\frac{8}{13} + \frac{11}{23} + \frac{9}{17} + \frac{14}{39}$$

$$8 \times 23 \times 17 \times 39 = 121992$$

$$11 \times 13 \times 17 \times 39 = 94809$$

$$9 \times 13 \times 23 \times 39 = 104949$$

$$14 \times 13 \times 23 \times 17 = 71162$$


---


$$13 \times 23 \times 17 \times 39 = \frac{392912}{198237} = 1 \frac{194675}{198237}$$

(6)

$$\frac{21}{42} + \frac{41}{53} + \frac{71}{89} + \frac{22}{23}$$

$$21 \times 53 \times 89 \times 23 = 2278311$$

$$41 \times 42 \times 89 \times 23 = 3524934$$

$$71 \times 42 \times 53 \times 23 = 3635058$$

$$22 \times 42 \times 53 \times 89 = 4358508$$


---


$$42 \times 53 \times 89 \times 23 = \frac{13796811}{4556622} = 3 \frac{126913}{4556622}$$

No.

ANSWERS.

(7)

$$\frac{2}{3} \text{ of } \frac{6}{7} + \frac{2}{13} + \frac{2}{3} \text{ of } \frac{7}{8}$$

$$12 \times 13 \times 24 = 3744$$

$$2 \times 35 \times 24 = 1680$$

$$14 \times 35 \times 13 = 6370$$


---


$$35 \times 13 \times 24 = \frac{11794}{10920} = \frac{874}{10920}$$

(8)

$$\frac{4}{7} \times \frac{9}{13} \text{ of } \frac{12}{19} + \frac{4}{9} \text{ of } 5\frac{1}{2}$$

$$4 \times 247 \times 18 = 17784$$

$$108 \times 7 \times 18 = 13608$$

$$44 \times 7 \times 247 = 76076$$


---


$$7 \times 247 \times 18 = \frac{107468}{31122} = 3\frac{14102}{31122}$$

(9)

$$92\frac{5}{14} + 37\frac{8}{19} + 7\frac{4}{6} = 92\frac{285}{798} + 37\frac{336}{798} + 7\frac{532}{798} = 137\frac{355}{798}$$

$$\frac{1153}{798} = 1\frac{355}{798}$$

(10)

$$\frac{21}{23} \times \frac{11}{15} \text{ of } 2\frac{2}{3} + \frac{2}{9} \text{ of } 6\frac{2}{8}$$

$$21 \times 45 \times 27 = 25515$$

$$88 \times 23 \times 27 = 54648$$

$$40 \times 23 \times 45 = 41400$$


---


$$23 \times 45 \times 27 = \frac{121563}{27945} = 4\frac{9783}{27945}$$

(11)

$$\frac{17}{19} \text{ of } \frac{23}{49} \text{ of } 17\frac{4}{9} + \frac{4}{7} \text{ of } 12$$

$$61387 \times 7 = 429709$$

$$6379 \times 48 = 402192$$


---


$$8379 \times 7 = \frac{831901}{58653} = 14\frac{10759}{58653}$$

No.

ANSWER.

$$(12) \quad \frac{13}{27} + \frac{19}{23} \text{ of } 9\frac{2}{3} + \frac{11}{35} \text{ of } 8\frac{4}{7}$$

$$13 \times 69 \times 245 = 219765$$

$$551 \times 27 \times 245 = 3644865$$

$$660 \times 27 \times 69 = 1229580$$

$$27 \times 69 \times 245 = \frac{5094210}{456435} = 11\frac{73425}{456435}$$

## SUBTRACTION.

No.

ANSWERS.

$$(1) \quad \frac{4}{7} - \frac{3}{4}$$

$$4 \times 4 = 16$$

$$3 \times 7 = 21$$

$$\frac{16}{28} - \frac{21}{28}$$

$$\frac{5}{28}$$

$$7 \times 4 = 28$$

(2)

$$\frac{6}{11} - \frac{8}{9}$$

$$6 \times 9 = 54$$

$$8 \times 11 = 88$$

$$\frac{54}{99} - \frac{88}{99}$$

$$\frac{34}{99}$$

$$11 \times 9 = 99$$

(3)

$$\frac{7}{15} - \frac{4}{13}$$

$$7 \times 13 = 91$$

$$4 \times 15 = 60$$

$$\frac{91}{195} - \frac{60}{195}$$

$$\frac{31}{195}$$

$$15 \times 13 = 195$$

No.

ANSWERS.

$$(4) \quad \frac{9}{13} - \frac{6}{19}$$

$$9 \times 19 = 171$$

$$6 \times 13 = 78$$

$$\frac{171}{247} - \frac{78}{247}$$

$$\frac{93}{247}$$

$$13 \times 19 = 247$$

(5)

$$4\frac{1}{2} - \frac{9}{16}$$

$$9 \times 16 = 144$$

$$9 \times 2 = 18$$

$$\frac{144}{126} - \frac{18}{126}$$

$$\frac{126}{32}$$

$$2 \times 16 = 32 =$$

(6)

$$\frac{27}{8} - 5\frac{4}{7}$$

$$27 \times 7 = 189$$

$$39 \times 8 = 312$$

$$\frac{189}{56} - \frac{312}{56}$$

$$\frac{123}{56}$$

$$8 \times 7 = 56 \quad 2\frac{11}{56}$$

ANSWERS.

$$2\frac{1}{8} - 3\frac{2}{5}$$

$$\times 5 = 85$$

$$\times 8 = 136$$


---

$$\times 5 = \frac{51}{40} = 1\frac{11}{40}$$

$$6\frac{4}{7} - 9\frac{1}{110}$$

$$\times 10 = 460$$

$$\times 7 = 637$$


---

$$\times 10 = \frac{177}{70} = 2\frac{37}{70}$$

No.

ANSWER.

$$(9) \quad \frac{9}{11} - \frac{1}{13} \text{ of } 4$$

$$9 \times 13 = 117$$

$$4 \times 11 = 44$$


---


$$11 \times 13 = \frac{73}{143}$$

ANSWERS.

$$\frac{11}{54} - \frac{3}{28} \text{ of } \frac{5}{6}$$

$$11 \times 168 = 1848$$

$$13 \times 54 = 810$$


---

$$54 \times 168 = \frac{1038}{9072} = \frac{178}{1512}$$

$$169 - 14\frac{3}{7}$$

$$169 \times 7 = 1183$$

$$101 \times 1 = 101$$


---

$$1 \times 7 = \frac{1082}{7} = 154\frac{4}{7}$$

$$76\frac{1}{4} - \frac{2}{3} \text{ of } 19$$

$$305 \times 3 = 915$$

$$38 \times 4 = 152$$


---

$$4 \times 8 = \frac{763}{12} = 63\frac{7}{12}$$

## MULTIPLICATION.

No.      ANSWERS.

$$(1) \quad \frac{3}{4} \times \frac{5}{8}$$

$$\frac{3}{4} \times \frac{5}{8} = \frac{15}{32}$$

$$(2) \quad \frac{7}{9} \times \frac{8}{11}$$

$$\frac{7}{9} \times \frac{8}{11} = \frac{56}{99}$$

$$(3) \quad \frac{9}{11} \times \frac{11}{12}$$

$$\frac{9}{11} \times \frac{11}{12} = \frac{99}{132} = \frac{3}{4}$$

$$(4) \quad \frac{4}{13} \times \frac{4}{27}$$

$$\frac{4}{13} \times \frac{4}{27} = \frac{16}{351}$$

$$(5) \quad 8\frac{3}{4} \times \frac{5}{12}$$

$$\frac{35}{4} \times \frac{5}{12} = \frac{175}{48} = 3\frac{31}{48}$$

No.      ANSWERS.

$$(6) \quad 7 \times \frac{5}{13}$$

$$\frac{7}{1} \times \frac{5}{13} = \frac{35}{13} = 2\frac{9}{13}$$

$$(7) \quad 5\frac{3}{8} \times 11\frac{1}{4}$$

$$\frac{43}{8} \times \frac{45}{4} = \frac{1935}{32} = 60\frac{15}{32}$$

$$(8) \quad 3\frac{5}{8} \times 4\frac{5}{6}$$

$$\frac{29}{8} \times \frac{29}{6} = \frac{841}{48} = 17\frac{25}{48}$$

$$(9) \quad 8\frac{2}{3} \text{ of } \frac{7}{8}$$

$$\frac{26}{3} \times \frac{14}{24} = \frac{364}{72} = 5\frac{1}{18}$$

$$(10) \quad 16 \times \frac{4}{7} \text{ of } \frac{8}{13}$$

$$\frac{16}{1} \times \frac{32}{91} = \frac{512}{91} = 5\frac{57}{91}$$

No.      ANSWERS.

$$(11) \quad 17\frac{2}{5} \times \frac{17}{19} \text{ of } 7\frac{4}{9}$$

$$\frac{87}{5} \times \frac{1139}{171} = \frac{99093}{855} = 115\frac{256}{285}$$

$$(12) \quad 24\frac{7}{13} \times \frac{13}{16} \text{ of } 9\frac{1}{9}$$

$$\frac{319}{13} \times \frac{1066}{144} = \frac{340054}{1872} = 181\frac{611}{936}$$

## DIVISION.

No.

ANSWERS.

(1)

$$\frac{14}{5} \div \frac{11}{12}$$

$$\frac{14}{5} \times \frac{12}{11} = \frac{168}{55} = 3\frac{3}{55}$$

(2)

$$\frac{21}{80} \div \frac{3}{10}$$

$$\frac{21}{80} \times \frac{10}{3} = \frac{210}{240} = \frac{7}{8}$$

(3)

$$\frac{15}{16} \div \frac{4}{5}$$

$$\frac{15}{16} \times \frac{5}{4} = \frac{75}{64} = 1\frac{11}{64}$$

(4)

$$\frac{33}{35} \div \frac{3}{8}$$

$$\frac{33}{35} \times \frac{8}{3} = \frac{264}{105} = 2\frac{54}{105}$$

(5)

$$\frac{12}{37} \div \frac{18}{43}$$

$$\frac{12}{37} \times \frac{43}{18} = \frac{516}{666} = \frac{86}{111}$$

(6)

$$\frac{16}{351} \div \frac{4}{27}$$

$$\frac{16}{351} \times \frac{27}{4} = \frac{432}{1404} = \frac{12}{99}$$

(7)

$$5\frac{5}{7} \div \frac{5}{7}$$

$$\frac{40}{7} \times \frac{7}{5} = \frac{280}{35} = 8$$

No.

ANSWERS.

$$(8) \quad 3\frac{31}{48} \div \frac{5}{12}$$

$$\frac{175}{48} \times \frac{12}{5} = \frac{2100}{240} = 8\frac{3}{4}$$

$$(9) \quad 9\frac{1}{6} \div 9\frac{1}{2}$$

$$\frac{19}{6} \times \frac{2}{19} = \frac{38}{114} = \frac{19}{57}$$

$$(10) \quad 9\frac{1}{6} \div \frac{1}{2} \text{ of } 7$$

$$\frac{55}{6} \times \frac{2}{7} = \frac{110}{42} = 2\frac{13}{21}$$

$$(11) \quad 116\frac{4}{15} \div \frac{1}{3} \text{ of } 5\frac{1}{3}$$

$$\frac{1744}{15} \times \frac{9}{16} = \frac{15696}{240} = 65\frac{2}{5}$$

$$(12) \quad \frac{2}{3} \text{ of } \frac{3}{4} \div \frac{1}{2} \text{ of } \frac{2}{3}$$

$$\frac{6}{12} \times \frac{6}{2} = \frac{36}{24} = 1\frac{1}{2}$$

## PROPORTION.

No

ANSWER.

$$(1) \quad \begin{array}{ccccccc} \text{yd.} & & \text{yd.} & & \text{s.} & \text{d.} & \\ 1 & : & \frac{3}{4} & : : & 13 & 6 & : ? \\ & & & & 12 & & \\ & & & & \hline & & & & 162d. & & \\ & & & & \hline \end{array}$$

$$62 \times \frac{3}{4} = 162 \times 3 \div 4 = 121\frac{1}{2}d. = 10s. 1\frac{1}{2}d.$$

No.

ANSWERS.

(2)

$$\begin{array}{ccccccc} \text{lb} & & \text{lb} & \text{oz.} & & s. & \\ j & : & 1 & 14 & : : & \frac{3}{4} : ? \end{array}$$

$$1 \text{ lb} = 16 \text{ oz.}$$

$$1 \text{ lb } 14 \text{ oz.} = 30 \text{ oz.}$$

$$\frac{\frac{3}{4} \times 30d.}{16} = \frac{3s. \times 30}{4 \times 16}$$

$$3s. \times 30 \div 4 \div 16 = 1s. 4\frac{1}{8}d.$$

(3)

$$\begin{array}{ccccccc} \text{oz.} & & \text{oz.} & & s. & & \\ 1 & . & \frac{3}{4} & : : & 5\frac{3}{4} : ? \end{array}$$

$$5\frac{3}{4}s. \times \frac{3}{4} = \frac{17}{8} \times \frac{3}{4} = \frac{17s. \times 3}{8 \times 4} = \frac{51s.}{32}$$

$$12 \div 51 = 4s. 3d.$$

(4)

$$\begin{array}{ccccccc} \text{yds.} & & \text{yd.} & & s. & & \\ \frac{7}{8} & : & \frac{1}{4} & : : & \frac{5}{6} : ? \end{array}$$

$$\frac{5}{6} \times \frac{1}{4} \div \frac{7}{8} = \frac{5}{6} \times \frac{1}{4} \times \frac{8}{7} = \frac{5 \times 8}{6 \times 4 \times 7} = \frac{40}{168} = \frac{5}{21}s. = \frac{60}{21}d.$$

$$21 \div 60 = 2\frac{1}{4}d.$$

(5)

$$\begin{array}{ccccccc} \text{yds.} & & \text{yds.} & & s. & & \\ 2\frac{1}{2} & : & 4\frac{3}{4} & : : & 3\frac{1}{2} : ? \end{array}$$

$$\frac{5}{2} : \frac{19}{4} : : \frac{10}{3} : ?$$

$$\frac{10}{3} \times \frac{19}{4} \div \frac{5}{2} = \frac{10}{3} \times \frac{19}{4} \times \frac{2}{5} = \frac{10 \times 19 \times 2}{3 \times 4 \times 5}$$

$$8 \times 19 \times 2 = 304, 304 \div 60 = 5s. 4d.$$



No.

ANSWERS.

$$(6) \quad \frac{3}{16} : \frac{5}{32} :: 273\frac{1}{8} : ?$$

$$\frac{3}{16} : \frac{5}{32} :: \frac{2185}{8} : ?$$

$$\frac{2185}{8} \times \frac{5}{32} \div \frac{3}{16} = \frac{2185}{8} \times \frac{5}{32} \times \frac{16}{3} =$$

$$\frac{\text{£} \quad 2185 \times 5 \times 16}{8 \times 32 \times 3}$$

$$32 \times 8 \times 3 = 768, \quad 2185 \times 5 \times 16 = 174800 \div d.$$

$$768 = 227\text{l. } 12\text{s. } 1\text{d.}$$

$$(7) \quad \begin{array}{l} \text{yds.} \quad \text{yds.} \quad \text{£} \quad \text{s.} \quad \text{d.} \\ 7\frac{5}{8} : 49\frac{3}{11} :: 7 \ 18 \ 4 : ? \\ \frac{61}{8} : \frac{542}{11} :: 7 \ 18 \ 4 : ? \end{array}$$

$$\text{£} \quad \text{s.} \quad \text{d.} \quad \text{£} \quad \text{s.} \quad \text{d.}$$

$$7 \ 18 \ 4 \times \frac{542}{11} \div \frac{61}{8} = 7 \ 18 \ 4 \times \frac{542}{11} \times \frac{8}{16} =$$

$$\frac{\text{£} \quad \text{s.} \quad \text{d.} \quad 7 \ 18 \ 4 \times 542 \times 8}{11 \times 61}$$

$$11 \times 61 = 671, \quad 7\text{l. } 18\text{s. } 4\text{d.} = 1900\text{d.} \times 542 \times 8 = 8238400\text{d}$$

$$\div 671 = 12277\frac{3}{4}\text{d.} = 51\text{l. } 3\text{s. } 1\frac{3}{4}\text{d.}$$

$$(8) \quad \begin{array}{l} \text{£} \quad \text{£} \quad \text{s.} \quad \text{d.} \quad \text{£} \\ 100 : 362 \ 8 \ 7\frac{1}{2} :: 98\frac{1}{8} : ? \\ 48000 \text{ half } d. : 173967 \text{ half } d. :: 19\frac{1}{8} : ? \end{array}$$

$$\frac{\text{£} \quad 791}{8} \times 173967 \div 48000 = \frac{\text{£} \quad 791 \times 173967}{8 \times 84000}$$

$$48000 \times 8 = 384000, \quad 173967 \times 791 = 137607897 \div$$

$$384000 = 358\text{l. } 7\text{s. } 0\frac{3}{4}\text{d.}$$

## ANSWERS.

$$\begin{array}{rcl}
 \text{s.} & \text{£} & \text{yds.} \\
 9\frac{1}{7} & : 2\frac{3}{11} & :: 4\frac{5}{6} : ? \\
 \frac{64}{7} & : \frac{25}{11} & :: \frac{29}{6} : ? \\
 \frac{64}{7} & : \frac{500}{11} & :: \frac{29}{6} : ?
 \end{array}$$

$$\begin{aligned}
 \times \frac{500}{11} \div \frac{64}{7} &= \frac{29}{6} \times \frac{500}{11} \times \frac{7}{64} = \frac{29 \times 500 \times 7}{6 \times 11 \times 64} \\
 \times 11 \times 64 &= 4224, \quad 29 \times 500 \times 7 = 101500 \div \\
 &4224 = 24 \text{ yards.}
 \end{aligned}$$

## DECIMAL FRACTIONS.

## ADDITION.

ANSWERS.	No.	ANSWERS.
671.458	(5)	4541.03777
806.698	(6)	7396.1403
1133.372	(7)	5558.5850
1874.2784	(8)	1341.58517

## SUBTRACTION.

ANSWERS.	No.	ANSWERS.
67.517	(6)	182.7044
8.045	(7)	70.0346
34.1202	(8)	810.8879
297.6121	(9)	242.245787
669.021	(10)	327.2158

## MULTIPLICATION

No.	ANSWERS.	No.	ANSWERS.
(1)	$  \begin{array}{r}  .27 \\  27 \\  \hline  189 \\  54 \\  \hline  .0729 \\  \hline  \hline  \end{array}  $	(5)	$  \begin{array}{r}  .806 \\  .7 \\  \hline  .5642 \\  \hline  \hline  \end{array}  $
(2)	$  \begin{array}{r}  4.21 \\  8.41 \\  \hline  421 \\  1684 \\  1263 \\  \hline  14.3561 \\  \hline  \hline  \end{array}  $	(6)	$  \begin{array}{r}  .879 \\  10 \\  \hline  8.790 \\  \hline  \hline  \end{array}  $
(3)	$  \begin{array}{r}  97.04 \\  80.03 \\  \hline  29112 \\  7763200 \\  \hline  7766.1112 \\  \hline  \hline  \end{array}  $	(7)	$  \begin{array}{r}  2300.7 \\  48.003 \\  \hline  69021 \\  18405600 \\  92028 \\  \hline  110440.5021 \\  \hline  \hline  \end{array}  $
(4)	$  \begin{array}{r}  .4102 \\  .1004 \\  \hline  16408 \\  410200 \\  \hline  .04118408 \\  \hline  \hline  \end{array}  $	(8)	$  \begin{array}{r}  704.23 \\  .0007 \\  \hline  .492961 \\  \hline  \hline  \end{array}  $
		(9)	$  \begin{array}{r}  .786 \\  100 \\  \hline  78.6 \\  \hline  \hline  \end{array}  $

No. ANSWER.  
(10) 4.862  
      .75

24310  
      34034  
              
      3.6465

No. ANSWERS.  
(11) 200.05  
      002

        
      .40006  
              
(12) .00076  
      1000  
              
      .76  
            

## DIVISION.

No. ANSWERS.  
(1) 2.84)6.74(2.8803 +  
      468

2060  
      1872  
              
      1880  
      1872  
            

      800  
      702  
              
      98  
            

(2) .278)4.96(1.784 +  
      278

2180  
      1946  
            

      2840  
      2224  
            

      1160  
      1112  
              
      48  
            

No. ANSWERS.  
(3) .734)7.60(10.354 +  
      734

2600  
      2202  
            

      3980  
      3670  
            

      3100  
      2936  
              
      164  
            

(4) 4.06)7.23(1.7807 +  
      406

3170  
      2842  
            

      3280  
      3248  
            

      3200  
      2842  
              
      358

No.      ANSWERS.

$$(5) \quad \begin{array}{r} .001) .024(.024 \\ 24 \\ \hline \end{array}$$

$$(6) \quad \begin{array}{r} 10) 29.60 \\ \hline \end{array}$$

$$\begin{array}{r} 2.96 \\ \hline \end{array}$$

$$(7) \quad \begin{array}{r} 38.07) 724.1(19 \ 0202 \ + \\ 380.7 \\ \hline \end{array}$$

$$\begin{array}{r} 84840 \\ \hline \end{array}$$

$$\begin{array}{r} 34263 \\ \hline \end{array}$$

$$\begin{array}{r} 7700 \\ \hline \end{array}$$

$$\begin{array}{r} 7614 \\ \hline \end{array}$$

$$\begin{array}{r} 8600 \\ \hline \end{array}$$

$$\begin{array}{r} 7614 \\ \hline \end{array}$$

$$\begin{array}{r} 986 \\ \hline \end{array}$$

$$(8) \quad \begin{array}{r} 9.0002) 82.0300(9.114 \ + \\ 81.0018 \\ \hline \end{array}$$

$$\begin{array}{r} 102820 \\ \hline \end{array}$$

$$\begin{array}{r} 90002 \\ \hline \end{array}$$

$$\begin{array}{r} 128180 \\ \hline \end{array}$$

$$\begin{array}{r} 90002 \\ \hline \end{array}$$

$$\begin{array}{r} 881780 \\ \hline \end{array}$$

$$\begin{array}{r} 860008 \\ \hline \end{array}$$

$$\begin{array}{r} 21772 \\ \hline \end{array}$$

No.      ANSWERS.

$$(9) \quad \begin{array}{r} 2.001) 7.624(3.81009 \ + \\ 6003 \\ \hline \end{array}$$

$$\begin{array}{r} 16210 \\ \hline \end{array}$$

$$\begin{array}{r} 16008 \\ \hline \end{array}$$

$$\begin{array}{r} 2020 \\ \hline \end{array}$$

$$\begin{array}{r} 2001 \\ \hline \end{array}$$

$$\begin{array}{r} 19000 \\ \hline \end{array}$$

$$\begin{array}{r} 18009 \\ \hline \end{array}$$

$$\begin{array}{r} 991 \\ \hline \end{array}$$

$$(10) \quad \begin{array}{r} .24121) .52130(.2161 \ + \\ 48242 \\ \hline \end{array}$$

$$\begin{array}{r} 38880 \\ \hline \end{array}$$

$$\begin{array}{r} 24121 \\ \hline \end{array}$$

$$\begin{array}{r} 147590 \\ \hline \end{array}$$

$$\begin{array}{r} 144726 \\ \hline \end{array}$$

$$\begin{array}{r} 28640 \\ \hline \end{array}$$

$$\begin{array}{r} 24121 \\ \hline \end{array}$$

$$\begin{array}{r} .4519 \\ \hline \end{array}$$

No.	ANSWERS.
(11)	
$\cdot 124689$	$31 \cdot 0000(248 \cdot 618 +$
	$249378$
	<hr/>
	606220
	498756
	<hr/>
	1074640
	997512
	<hr/>
	771280
	748184
	<hr/>
	281460
	124689
	<hr/>
	3067710
	997512
	<hr/>
	70198
	<hr/>

(12)	1000)3468.9
	<hr/>
	3.4689
	<hr/>

To reduce a vulgar fraction to a decimal.

(1)	8)5.000
	<hr/>
	625
	<hr/>

(2)	4)1.00
	<hr/>
	25
	<hr/>

No	ANSWERS.
(3)	8)7.000
	<hr/>
	875
	<hr/>
(4)	3)1.000
	<hr/>
	333 +
	<hr/>
(5)	6)5.000
	<hr/>
	833 +
	<hr/>
(6)	6)1.000
	<hr/>
	166 +
	<hr/>
(7)	16)9.0(.5625
	80
	<hr/>
	100
	96
	<hr/>
	40
	32
	<hr/>
	80
	80
	<hr/>
(8)	75)1.00(.0133 +
	75
	<hr/>
	250
	225
	<hr/>
	250
	225
	<hr/>
	25
	<hr/>

No.      ANSWERS.

(9)      17)16·0(·9411 +  
           153

---

 70

---

 68

---

 20

---

 17

---

 30

---

 17

---

 13

---

(10)      11)8·0000

---

 ·7272 +

---

(11)      3842 275·00(·0715 +  
           268·94

---

 6060

---

 3842

---

 22180

---

 19210

---

 2970

---

(12)      1875)1·0000(·00053 +  
           9375

---

 6250

---

 5625

---

 625

---

To reduce a decimal to a vulgar fraction.

No.      ANSWERS.

(13)       $\frac{25}{100} = \frac{1}{4}$

(14)       $\frac{625}{1000} = \frac{5}{8}$

(15)       $\frac{375}{1000} = \frac{3}{8}$

(16)       $\frac{5}{1000} = \frac{1}{200}$

(17)       $\frac{1}{100}$

(18)       $\frac{1}{1000}$

(19)       $\frac{41}{100}$

(20)       $\frac{21}{1000}$

(21)       $\frac{7}{1000}$

(22)       $\frac{19}{1000}$

To reduce numbers of a No.  
 er denomination to the  
 imal of a higher.

## ANSWERS.

$$\begin{array}{r}
 1) \quad 2)1\cdot0 \\
 \hline
 12)5\cdot500 \\
 \hline
 2,0)19\cdot458 \quad + \\
 \hline
 \pounds \cdot9729 \quad + \\
 \hline
 \hline
 \end{array}$$

$$\begin{array}{r}
 ) \quad 4)3\cdot00 \\
 \hline
 12)9\cdot7500 \\
 \hline
 20)15\cdot81250 \\
 \hline
 \pounds \cdot790625 \\
 \hline
 \hline
 \end{array}$$

$$\begin{array}{r}
 ) \quad 12) 4\cdot000 \\
 \hline
 2,0)13\cdot333 \\
 \hline
 \pounds 6666 \quad + \\
 \hline
 \hline
 \end{array}$$

$$\begin{array}{r}
 ) \quad 12)9\cdot00 \\
 \hline
 20) \cdot7500 \\
 \hline
 \pounds \cdot0375 \\
 \hline
 \hline
 \end{array}$$

$$\begin{array}{r}
 ) \quad 28)8\cdot0000 \\
 \hline
 4)2\cdot28571 \quad + \\
 \hline
 \text{Cwt. } 3\cdot57142 \\
 \hline
 \hline
 \end{array}$$

## ANSWERS.

$$(28) \quad 12)3\cdot00$$

$$3)4\cdot2500$$

$$\text{Yds. } 1\cdot4166 \quad +$$

$$(29) \quad 60)34\cdot0$$

$$60)26\cdot56666$$

$$24) \cdot44277$$

$$7) \cdot01844$$

$$\text{Week } 00263 \quad +$$

$$(30) \quad 40)3\cdot000$$

$$8)5\cdot07500$$

$$\text{Mile } \cdot63437$$

$$(31) \quad 4)3\cdot00$$

$$12)4\cdot7500$$

$$21) \cdot3958 \quad +$$

$$\text{Guin. } \cdot0188 \quad +$$

$$(32) \quad 24)12\cdot0$$

$$20) 5\cdot50$$

$$\text{oz. } \cdot275$$



No.	ANSWERS.
(33)	$\begin{array}{r} 40)12\cdot0 \\ \hline 4) 2\cdot300 \\ \hline \text{Acre } \underline{\underline{.575}} \end{array}$

(34)	$\begin{array}{r} 12)6\cdot0 \\ \hline 3) 1\cdot5 \\ \hline 5\frac{1}{2})17\cdot5000 \\ \hline 40) 3\cdot18181 \\ \hline 8) \cdot07954 \\ \hline \text{Mile } \underline{\underline{\cdot00994}} \end{array}$
------	---

To find the value of a decimal.

(35)	$\begin{array}{r} \text{£} \\ \cdot7634 \\ 20 \\ \hline 15\cdot2680 \\ 12 \\ \hline 3\cdot2160 \\ 4 \\ \hline \underline{\underline{\cdot8640}} = 15s. 3d. \end{array}$
------	---

No.	ANSWERS.
(36)	$\begin{array}{r} \text{£} \\ \cdot8412 \\ 20 \\ \hline 6\ 8240 \\ 12 \\ \hline 9\cdot8880 \\ 4 \\ \hline 3\cdot5520 = 6s. 9\frac{1}{4} \end{array}$
(37)	$\begin{array}{r} \text{£} \\ \cdot0076 \\ 20 \\ \hline \cdot1520 \\ 12 \\ \hline 1\cdot8240 \\ 4 \\ \hline 3\cdot2960 = 1\frac{1}{4} \end{array}$

(38)	$\begin{array}{r} \text{cwt.} \\ \cdot764 \\ 4 \\ \hline 3\cdot056 \\ 28 \\ \hline 1\cdot568 \\ 16 \\ \hline 9\cdot088 \\ 16 \\ \hline \underline{\underline{1\cdot408}} \end{array}$
------	---

3 qrs. 1 lb. 9 oz. 1 dr.

## ANSWERS.

lb.  
 $\cdot 936$   
 16  


---

 $14\cdot 976$   
 16  


---

 $15\cdot 616$   


---

 14 ozs. 15 drs.

ton.  
 $\cdot 007$   
 20  


---

 $\cdot 140$   
 4  


---

 $\cdot 560$   
 20  


---

 $15\cdot 680$   
 16  


---

 $10\cdot 880$   
 16

$14\cdot 080$   


---

 5 lb. 10 oz. 14 dr.

s.  
 $\cdot 732$   
 12  


---

 $8\cdot 784$   
 4  


---

 $8\cdot 136 = 8\frac{1}{4}d.$   


---

## No.

## ANSWERS.

(42) crown.  
 $\cdot 079$   
 5  


---

 $\cdot 895$   
 12  


---

 $4\cdot 740$   
 4  


---

 $2\cdot 960 = 4\frac{1}{2}d.$   


---

(43) day.  
 $\cdot 9218$   
 24  


---

 $22\cdot 1232$   
 60  


---

 $7\cdot 3920$   
 60  


---

 $23\cdot 5200$   


---

 22 hrs. 7 min. 23 secs.

(44) yards.  
 $496$   
 4  


---

 $1\cdot 984$   
 4  


---

 $3\cdot 936$   
 $2\frac{1}{4}$   


---

 $2\cdot 106$   


---

 1 qr. 3 nls. 2 in.  
 6 3

No.	ANSWER.	No.	ANSWER.
	mile.		lb.
(45)	·0796	(46)	·732
	8		12
	<hr/>		<hr/>
	·6368		8·784
	40		20
	<hr/>		<hr/>
	25·4720		15·680
	5½		24
	<hr/>		<hr/>
	2·5960		16·320
	3		<hr/>
	<hr/>		<hr/>
	1·7880		8 oz. 15 dwt. 16 gr.
	12		
	<hr/>		
	9·4560		
	<hr/>		
	<hr/>		
	25 perch. 2 yds. 1 ft. 9in.		

## CIRCULATING DECIMALS.

No.                      ANSWERS.

(1) 0·5' is a pure repetend : hence it is equal to  $\frac{5}{9}$ .

(2) 0·8' is a pure repetend : hence it is equal to  $\frac{8}{9}$ .

(3) 0·73' is a pure periodical containing two places hence its denominator consists of two nines ; and is equal to  $\frac{73}{99}$ .

(4) 0·145' is a pure periodical containing three places hence its denominator consists of three nines ; and it is equal to  $\frac{145}{999}$ .

(5) 0·83'25' is a mixed periodical, of which the finite part is 83, and the infinite 25 : hence the numerator of the equivalent vulgar fractions  $8325 - 83 = 8242$ . Since the infinite part consists of two places, then there are two nines in the required denominator ; and, since the finite part consists of two places there are two cyphers in it. Therefore the required fraction is  $\frac{8242}{9900}$ .

(6) 0·147'658' is a mixed periodical, the finite part which is 147, and the infinite part 658. Hence the required

## ANSWERS.

erator is  $147658 - 147 = 147511$ . Since the infinite consists of three places, there are three nines in the minator; and since the finite part consists of three s, there are three cyphers in it. Therefore the required fraction is  $\frac{147511}{999000}$ .

)  $0.432'0075'$  is a mixed periodical, of which the finite is 432, and the infinite part 0075. Hence the required erator is  $4320075 - 432 = 4319643$ . Since the infinite consists of four places, there are four nines in the denominator; and since the finite part consists of three places, there are three cyphers in it. Therefore the required vulgar ion is  $\frac{4319643}{9999000}$ .

)  $0.82'756'$  is a mixed periodical, the finite part of h is 82; hence the required numerator is  $82756 - 82 = 82674$ . Three places in the infinite part give three nines: two places in the finite part, two cyphers, in the denominator. The required number is therefore,  $301 \frac{82674}{999000}$ .

## DUODECIMALS, OR CROSS MULTIPLICATION.

ANSWERS.				
ft.	in.	"		
7	9	0		
5	6	0		
<hr/>				
38	9	0		
3	10	6		
<hr/>				
42	7	6		
<hr/>				
ft.	in.	"	'''	''''
9	5	3	0	0
4	8	6	0	0
<hr/>				
37	9	0	0	0
6	3	6	0	0
0	4	8	7	6
<hr/>				
44	5	2	7	6
<hr/>				

No.	ANSWERS.				
	ft.	in.	"	'''	''''
(3)	12	8	7	0	0
	8	4	9	0	0
	<hr/>				
	101	8	8	0	0
	4	2	10	4	0
	0	9	6	5	3
<hr/>					
	106	9	0	9	3
<hr/>					
	ft.	in.	"	'''	''''
(4)	46	11	8	0	0
	12	0	7	0	0
	<hr/>				
	563	8	0	0	0
	2	3	4	9	8
<hr/>					
	565	11	4	9	8
<hr/>					

No.	ANSWERS.				
	ft.	in.	"	'''	''''
(5)	87	9	6	0	0
	11	10	3	0	0
	<hr/>				
	965	8	6	0	0
	73	1	11	0	0
	1	9	11	4	6
	<hr/>				
	1040	8	4	4	6
	<hr/>				
	ft.	in.	"	'''	''''
(6)	687	7	9	0	0
	24	10	6	0	0
	<hr/>				
	16503	6	0	0	0
	573	0	5	6	0
	28	7	9	10	6
	<hr/>				
	17105	2	3	4	6
	<hr/>				

No.	ANSWERS.		
	ft.	in.	"
(7)	8	4	0
	3	4	0
	<hr/>		
	25	0	0
	2	9	4
	<hr/>		
	27	9	4
	<hr/>		
	ft.	in.	"
(8)	10	9	0
	6	4	0
	<hr/>		
	64	6	0
	3	7	0
	<hr/>		
	68	1	0
	<hr/>		

No.	ANSWERS.		
	ft.	in.	"
(9)	6	4	0
	3	2	0
	<hr/>		
	19	0	0
	1	0	8
	<hr/>		
5s. = $\frac{1}{4}$	20	0	8
	<hr/>		
2s = $\frac{1}{10}$	5	0	0
	2	0	0
	<hr/>		
	$4\frac{1}{2} - \frac{2}{3}$		
	<hr/>		
	£7	0	$4\frac{1}{2} - \frac{2}{3}$
	<hr/>		

s.  
7  
12  

---

81  

---

4 $\frac{1}{2}$

8" =  $\frac{1}{18}$ ) 81

## ANSWERS.

ft.	in.	"
23	9	0
23	9	0

546	3	0
17	9	9

564	0	9
-----	---	---

ft.	in.
7	2
3	6

21	6
3	7

s. d.

5 2

12

1 in. =  $\frac{1}{12}$  625s. =  $\frac{1}{4}$  25 12d. =  $\frac{1}{30}$  6 5 0

0 4 2

5 -  $\frac{1}{6}$ 5 -  $\frac{1}{6}$ £ 6 9 7 -  $\frac{1}{6}$ 

ft. in.

26 9

12 4

321 0

8 11

5s. 0d. =  $\frac{1}{4}$  329 11s. 6d. =  $\frac{1}{4}$  82 5 0s. 2d. =  $\frac{1}{15}$  41 2 6

2 14 10

7 0  $\frac{1}{4}$  -  $\frac{1}{8}$ £126 9 4  $\frac{1}{4}$  -  $\frac{1}{8}$ 

s. d.

6 in. =  $\frac{1}{2}$  7 83 in. =  $\frac{1}{4}$  3 102 in. =  $\frac{1}{3}$  1 111 3  $\frac{1}{4}$  -  $\frac{1}{8}$ 7 0  $\frac{1}{4}$  -  $\frac{1}{8}$

## No.      ANSWERS.

(13)      ft.   in.   "   '   ''  
           321   7   3   0   0  
              9   3   6   0   0

2894   5   3   0   0  
       80   4   9   9   0  
       13   4   9   7   6

2988   2   10   4   6

(14)      ft.   in.   "  
           75   9   0  
           17   7   0

1287   9   0  
       44   2   3

1331   11   3

(15)      ft.   in.   "  
           75   7   0  
              9   8   0

680   3   0  
       50   4   8

730   7   8

(16)      ft.   in.   "   '   ''  
           39   10   7   0   0  
           18   8   4   0   0

717   10   6   0   0  
       26   7   0   8   0  
        1   1   3   6   4

745   6   10   2   4

## No.      ANSWERS.

(17)      ft.   in.   "  
           9   2   0  
           5   8   0

45   10   0  
       6   1   4

51   11   4  
       2   3   0

103   10   8  
       12   11   10

116   10   6

(18)      ft.   in.   "   ''  
           6   6   0   0  
           4   9   0   0

26   0   0   0  
       4   10   6   0

30   10   6   0  
       3   3   0   0

92   7   6   0  
       7   8   7   6

100   4   1   6

No. (19)	ANSWER.					
	ft.	in.	"	'''	''''	'''''
	72	7	6	0	0	0
	5	6	3	0	9	0
<hr/>						
	363	1	6	0	0	0
	36	3	9	0	0	0
	1	6	1	10	6	0
<hr/>						
	400	11	4	10	6	0
	8	6	4	0	0	0
<hr/>						
	3207	7	3	0	0	0
	200	5	8	5	3	0
	11	1	7	9	7	6
<hr/>						
	3419	2	7	2	10	6
<hr/> <hr/>						

No.	ANSWER.		
	ft.	in.	"
(20)	18	4	0
	12	9	0
<hr/>			
	220	0	0
	13	9	0
<hr/>			
	233	9	0
	9	6	0
<hr/>			
	2103	9	0
	116	10	6
<hr/>			
27)	2220	7	6
<hr/>			
6d. = $\frac{1}{2}$ )	82	2	11 $\frac{1}{2}$
<hr/>			
2,0)	4,1	0	0
<hr/>			
	£2	1	0
<hr/> <hr/>			

## EQUATION OF PAYMENTS.

No.	ANSWERS.	
(1)	£	£
	200 × 3 =	600
	150 × 4 =	600
	250 × 6 =	1500
<hr/>		
	600	
<hr/>		
	2700 (4 $\frac{1}{2}$ months.	
	2400	
<hr/>		
	300 = $\frac{1}{2}$	
<hr/>		
	£	£
3)	50 × 2 =	100
	40 × 3 $\frac{1}{2}$ =	140
	20 × 4 $\frac{1}{2}$ =	90
<hr/>		
	110	
<hr/>		
	110)330 (3 years.	
	330	
<hr/>		



## EXCHANGE.

No.

ANSWERS.

$$(1) \quad \begin{array}{r} 100 \\ 7 \\ \hline 700 \end{array} : \begin{array}{r} 104\frac{5}{7} \\ 7 \\ \hline 733 \end{array} :: \begin{array}{r} \text{g.} \\ 374 \\ 20 \\ \hline 7492 \end{array} \text{ st. } 12 : ?$$

$$7492 \times 733 \div 700 = 7845 \text{ st. } 3\text{p. } \frac{19}{175} \text{ or}$$

$$\begin{array}{r} \text{g.} \\ 392 \\ \text{st.} \\ 5 \\ \text{p.} \\ 3\frac{19}{175} \end{array}$$

$$(2) \quad \begin{array}{r} 100 \\ 9 \\ \hline 900 \end{array} : \begin{array}{r} 104\frac{5}{9} \\ 9 \\ \hline 941 \end{array} :: \begin{array}{r} \text{g.} \\ 4378 \\ 20 \\ \hline 87568 \end{array} \text{ st. } 8 : ?$$

$$87568 \times 941 \div 900 = 91557 \text{ st. } 3\frac{77}{225} \text{ p. or}$$

$$\begin{array}{r} \text{g.} \\ 4577 \\ \text{st.} \\ 17 \\ \text{p.} \\ 3\frac{77}{225} \end{array}$$

$$(3) \quad \begin{array}{r} 104\frac{5}{6} \\ 6 \\ \hline 629 \end{array} : \begin{array}{r} 100 \\ 6 \\ \hline 600 \end{array} :: \begin{array}{r} 58734 \\ 20 \times 16 \\ \hline 18795035 \end{array} \text{ p. } 9 \text{ } 11 : ?$$

$$18795035 \times 600 \div 629 = 17928491\frac{161}{289} \text{ pennings, or}$$

$$\begin{array}{r} \text{g.} \\ 56026 \\ \text{st.} \\ 10 \\ \text{p.} \\ 11\frac{161}{289} \end{array}$$

$$(4) \quad \begin{array}{r} 104\frac{5}{7} \\ 7 \\ \hline 734 \end{array} : \begin{array}{r} 100 \\ 7 \\ \hline 700 \end{array} :: \begin{array}{r} 4326 \\ 20 \\ \hline 86535 \end{array} \text{ st. } 15 : ?$$

$$86535 \div 700 \times 734 = 82526 \text{ } 9\frac{25}{367} \text{, or}$$

$$\begin{array}{r} \text{g.} \\ 4126 \\ \text{st.} \\ 6 \\ \text{p.} \\ 9\frac{25}{367} \end{array}$$

o.

## ANSWERS.

$$\begin{array}{rcl}
 & \text{s.} & \text{d.} & \text{g.} & & \\
 \text{b)} & 33 & 3 & : & 1680 & : : \text{£}1 : ? \\
 \text{1s. 3d.} & = & 399\text{d.} & & & \\
 180 \text{ g.} & = & 33600 \text{ st.} & \left\{ & 33600 \times 2 \times 399 = 168 & \text{£} \text{ s.} \text{ d.} \\
 & = & 2 & & & 8 \quad 5\frac{1}{2}
 \end{array}$$

$$\begin{array}{rcl}
 & \text{s.} & \text{d.} & \text{g.} & \text{£} & \\
 \text{c)} & 33 & 11 & : & 6048 & : : 1 : ? \\
 33\text{s. 11d.} & = & 407\text{d.} & 6048 \text{ g.} & = & 120960 \text{ st.} \quad 1\text{l.} = 2. \\
 & & & 120960 \times 2 \div 407 = & 594\text{l.} & 7\text{s. } 11\frac{3}{4}\text{d.}
 \end{array}$$

$$\begin{array}{rcl}
 \text{d)} & \text{f.} & \text{c.} & \text{f.} & \text{c.} & \text{£} \\
 & 23\cdot49 & : & 17969\cdot85 & : : & 1 : ? \quad \frac{17969\cdot85}{23\cdot49} = 765.
 \end{array}$$

$$\begin{array}{rcl}
 & \text{f.} & \text{c.} & \text{f.} & \text{c.} & \text{£} \\
 \text{e)} & 23\cdot25 & : & 7672\cdot50 & : : & 1 : ? \quad \frac{7672\cdot5}{23\cdot25} = 330.
 \end{array}$$

$$\begin{array}{rcl}
 \text{£} & \text{£} & \text{s.} & \text{s.} & \text{d.} \\
 1 & : & 100 & 1 & : : 33 \quad 4 : ? \\
 \hline
 20\text{s.} & & 200 \text{ 1s.} & & 400 \text{ pence, or grotes.}
 \end{array}$$

$$\begin{array}{rcl}
 & \text{g.} & \text{st.} \\
 2001 \times 400 \div 20 \div 2 \div 20 & = & 1000 \quad 10 \\
 \text{f)} & \text{£} & \text{£} & \text{s.} & \text{d.} & \text{s.} & \text{d.} \\
 & 1 & : & 168 & 8 \quad 5 & : : & 33 \quad 3 : ? \\
 \hline
 240\text{d.} & & 40421\text{d.} & & 399\text{d.}
 \end{array}$$

$$40421 \times 399 \div 240 \div 2 \div 20 = 1680 \text{ gu.}$$

$$\begin{array}{rcl}
 \text{g)} & \text{£} & \text{£} & \text{s.} & \text{d.} & \text{f.} & \text{c.} \\
 & 1 & : & 274 & 5 \quad 9 & : : & 23\cdot57 : ? \\
 \hline
 240\text{d.} & & 65829\text{d.}
 \end{array}$$

$$65829 \times 23\cdot57 \div 240 = 6464\cdot96 \text{ f. c.}$$

138

## SECTION III.

No.

ANSWER.

(12) £ 1 : 765 : : 23.49 : ?  
23.49

f. 17969.85 c.

No.  
(13)

ANSWERS.

f. st.  
142 17

6)142(23l. 16s 2d.  
138

4  
20

20  
Add 17

6)97  
96

1  
x by 2

2 groats or pence

(15)

£ s. d.  
20 12 1  
6

£ 155 12s 1d

No.  
(14)

ANSWERS.

f. st.  
72 14

6)72(12l. 2s 4d.  
72

00  
14 st.

6)14  
12

2  
2  
4 5s

16

£ s.  
155 12  
1

£ 155 12s 1d

ARBITRATION OF EXCHANGE.

ANSWERS.

$$\begin{array}{rcccl} \text{£} & d & s. & d. & \\ 1 & : & 9\frac{1}{2} & : & : & 33 & 9 & : & ? \\ \text{£1} = 480 \text{ hd. } 9\frac{1}{2}d. & = & 19 \text{ hd. } 33s. & 9d. & = & 405d. \\ 405 \times 19 \div 480 & = & 16 \text{ pence.} \end{array}$$

$$\begin{array}{rcl} ? & : & \text{£1000} \\ \text{£1} & : & 35s. = 420d. \\ 19\frac{1}{2}d. & : & 1 \text{ fr.} \\ 300 \text{ fr.} & : & 60 \text{ duc.} \\ 1 \text{ duc.} & : & 360 \text{ mar.} \end{array}$$

$$\begin{array}{l} \text{mar.} \\ 1000 \times 420 \times 1 \times 60 \times 360 = 9072000000. \\ 1 \times 19\frac{1}{2} \times 300 \times 1 = 5800. \end{array}$$

$$9072000000 \div 5800 = 1564138 \text{ the equivalent for 1000} \text{ l.}$$

by circulating exchange.

$$\begin{array}{rcccl} d. & \text{£} & \text{Mar.} & & \\ 42\frac{1}{2} & : & 1000 & : & : & 272 & : & ? \\ 2 & & 20 & & & & & \end{array}$$

$$85 \text{ hd. } 20000, \text{ or } 480000 \text{ hd.}$$

$$80000 \times 272 \div 85 = 15360000 \text{ mar.} - \text{the equivalent for 1000} \text{ l. by direct exchange.}$$

Mar.

$$1564138 = 1000 \text{ l. by circular exchange.}$$

$$1536000 = 1000 \text{ l. by direct } "$$

$$34) 28138 = \text{gain.}$$

$$8) 827 = 20 \text{ mar.}$$

$$103 \text{ piastres } 3 \text{ reals, } 20 \text{ mar.}$$

No.

ANSWERS.

(3)  $d. \quad d. \quad £ \quad £$   
 $18\frac{3}{4} : 19\frac{1}{4} :: 100 : ? \quad \frac{100 \times 19\frac{1}{4}}{18\frac{3}{4}} = 104$   
 $£ \quad s. \quad d. \quad £ \quad £ \quad s. \quad d.$   
 or  $104 \quad 18 \quad 2\frac{1}{4} - 100 = 4 \quad 18 \quad 2\frac{1}{4}$  gain.

(4)  $d. \quad d. \quad £ \quad £$   
 $18\frac{1}{4} : 17\frac{3}{4} :: 100 : ? \quad \frac{100 \times 17\frac{3}{4}}{18\frac{1}{4}} = 98\frac{1}{4}$   
 $£ \quad s. \quad d. \quad £ \quad £ \quad s. \quad d.$   
 or  $98 \quad 3 \quad 10 - 100 = 1 \quad 16 \quad 2$  the loss.

## PROFIT AND LOSS.

No.

ANSWERS.

(1)  $d. \quad d.$   
 $14 \times 140 = 1960$   
 $10 \times 140 = 1400$   


---

  
 $12)560$  the gain.  


---

  
 $2,0)4,6 \quad 8d.$   


---

  
 $£2. \quad 6s. \quad 8d.$   


---


---

(2)  $cwt. \quad qrs. \quad lbs. \quad £ \quad s. \quad £ \quad s. \quad d.$   
 $5 \quad 3 \quad 14 \quad @ \quad 2 \quad 18 \quad \text{per cwt.} = 17 \quad 0 \quad 9$   
 $\text{Do.} \quad @ \quad 2 \quad 12 \quad ,, \quad 15 \quad 5 \quad 6$   


---

  
 The gain  $£1 \quad 15 \quad 3$   


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(3)  $£ \quad s.$   
 Price received  $= 57 \quad 10$   
 $6s. \quad 8d. \times 144 = 48 \quad 0$   


---

  
 The gain  $£ \quad 9 \quad 10$   


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ANSWERS.

1)  $6 : 8 :: 100 : 100 \times 8 \div 6 = 133\frac{1}{3} - 100 = 33\frac{1}{3}$  the gain per cent.

3)  $5 : 3 :: 100 : 100 \times 3 \div 5 = 60 - 100 = 40$  the loss per cent.

5)  $\begin{array}{r} \text{£ } s. \\ 9 \quad 8 \\ \hline 2256d. \end{array} : \begin{array}{r} \text{£ } s. \quad d. \\ 11 \quad 18 \quad 11 \\ \hline 2867d. \end{array} :: 100 : ?$   
 $100 \times 2867 \div 2256 = 127\frac{47}{56}$   
 $127\frac{47}{56} - 100 = 27\frac{47}{56}$  is the gain per cent.

(7)  $\begin{array}{r} \text{£} \\ 50 \\ \hline 1000s. \end{array} : \begin{array}{r} \text{£ } s. \\ 54 \quad 10 \\ \hline 1090s. \end{array} :: 100 : ?$   $\left\{ \begin{array}{l} 100 \times 1090 \div 1000 = 109 \\ 109 - 100 = 9 \text{ the} \\ \text{gain on 8 months.} \end{array} \right.$   
 ms. ms.  
 $8 : 12 :: 9 : 9 \times 12 \div 8 = 13\frac{1}{2}$  the gain per cent. per annum.

(8)  $\begin{array}{r} s. \quad d. \\ 11 \quad 6 \\ \hline 138d. \end{array} : \begin{array}{r} s. \\ 12 \\ \hline 144d. \end{array} :: 115 : ?$   $\left\{ \begin{array}{l} 115 \times 144 \div 138 = 120 \\ - 100 = 20 \text{ is the} \\ \text{required gain per cent.} \end{array} \right.$

(9)  $\begin{array}{r} \text{£} \\ 100 \\ 2 \\ \hline 200 \end{array} : \begin{array}{r} \text{£} \\ 112\frac{1}{2} \\ 2 \\ \hline 225 \end{array} :: \begin{array}{r} s. \quad d. \\ 4 \quad 8 \\ 12 \\ \hline \end{array}$   
 $56 \times 225 \div 200 \div 12 = 5 \quad s. \quad d. \quad 8$

(10)  $\begin{array}{r} s. \\ 16 \\ \hline \end{array} \times \begin{array}{r} s. \\ 180 \\ \hline \end{array} = 2880$  the total cost.

$\begin{array}{r} \text{£} \\ 125 \\ \hline \end{array} : \begin{array}{r} \text{£} \\ 100 \\ \hline \end{array} :: \begin{array}{r} s. \\ 28 \\ \hline \end{array} : \begin{array}{r} 28 \times 100 \div 125 = \\ 22 \quad 4\frac{2}{5} \end{array}$  the cost per cwt.

$\begin{array}{r} s. \quad d. \\ 22 \quad 4\frac{2}{5} \\ \hline 1075f. \end{array} : \begin{array}{r} s. \\ 2880 \\ \hline 138240f. \end{array} :: 112\text{lb.} : \begin{array}{r} 138240 \div 1075 = \\ 14402\text{lbs.} \end{array}$   
 180)14402lb. nearly, was the total weight.

80lbs. nearly the weight per cask.

No.

ANSWERS.

(11)

$$\begin{array}{ccccccc} \text{£} & & \text{£} & & \text{s.} & & \text{£} \text{ s.} \\ 90 & : & 100 & :: & 20 & : & \times 100 \div 90 = 1 \ 2 \end{array}$$

(12)

$$\begin{array}{ccccccc} \text{£} & & \text{£} & & & & \text{£} \text{ s.} \\ 110 & : & 100 & :: & 20 & : & \times 100 \div 110 = 0 \ 18 \end{array}$$

(13)

$$\begin{array}{ccccccc} \text{£} \text{ s.} & & & & \text{s.} \text{ d.} & & \\ 5 \ 14 & \div & 12 & = & 9 \ 6 & \text{the price per yard for which} \\ \text{sold:—} & & & & & & \end{array}$$

$$\begin{array}{ccccccc} \text{£} & & \text{£} & & \text{s.} \text{ d.} & & \text{s.} \\ 108 & : & 100 & :: & 9 \ 6 & : & \times 100 \div 108 = 8 \end{array}$$

## FELLOWSHIP.

No.

ANSWERS.

(1)

$$\begin{array}{ccccccc} \text{£} & & \text{£} & & \text{£} & & \text{£} \text{ s.} \\ 80 & : & 20 & :: & 30 & : & \times 20 \div 80 = 7 \ 10 \text{ A's} \\ \text{of the profit and } 20\text{l.} & - & 7\text{l. } 10\text{s.} & = & 12\text{l. } 10\text{s.} & \text{B's share} \end{array}$$

(2)

$$\begin{array}{ccccccc} \text{£} & & & & \text{£} & & \\ 500 & & & & & & \\ \hline 900 & & \text{£} & & \text{£} & & \\ 1400 & : & 1100 & :: & 500 & : & \times 1100 \div 1400 = \\ 392\text{l. } 17\text{s. } 1\frac{3}{4}\text{d.} & \text{E's share; and } 1100\text{l.} & - & 392\text{l. } 17\text{s. } 1\frac{3}{4}\text{d.} & & & \\ & & & & 707\text{l. } 2\text{s. } 10\frac{1}{4}\text{d.} & \text{H's share} \end{array}$$

(3) £

$$\begin{array}{ccccccc} 800 & & & & & & \text{£} \text{ s.} \\ 600 & & & & & & \\ \hline 400 & & \text{£} & & & & \\ 1800 & : & 100 & :: & 800 & : & \times 100 \div 1800 = 44 \ 4 \\ \text{B's share of the tax.} & & & & & & \\ 1800 & : & 100 & :: & 600 & : & \times 100 \div 1800 = 33 \ 3 \\ \text{C's share of the tax.} & & & & & & \end{array}$$

$$100\text{l.} - (44\text{l. } 8\text{s. } 10\frac{3}{4}\text{d.} + 33\text{l. } 6\text{s. } 8\text{d.}) = 22 \ 4 \text{ is D's share.}$$

No.

ANSWERS.

(4) 97

79

100	£	£		£	s.	d.
-----	---	---	--	---	----	----

$$276 : 34 :: 97 : \times 34 \div 276 = 11 \ 18 \ 11\frac{1}{4}$$

1st farmer's share.

$$276 : 34 :: 97 : \times 34 \div 276 = 9 \ 14 \ 7\frac{3}{4}$$

2nd farmer's share.

$$\text{And } 34l. - (11l. \ 18s. \ 11\frac{1}{4}d. + 9l. \ 14s. \ 7\frac{3}{4}d.) = 12 \ 6 \ 4\frac{1}{2}$$

the third farmer's share.

)	£	s.		£	s.
	89	5	$\times 5$	=	446 5
	92	15	$\times 7$	=	649 5
	98	10	$\times 11$	=	423 10

	£	s.		£	s.
1519	0	:	86	16	:: 446 5 :
30380s.			1736s.		8925s.

$$8295 \times 1736 \div 30380 \div 20 = 25l. \ 10s. \ \text{A's share.}$$

$$30380 : 1736 :: 649 \ 5 : ?$$

$$12985s. \times 1736 \div 30380 =$$

77. 2s. B's share.

$$\text{And } 86 \ 16 - (25 \ 10 + 37 \ 2) = 24 \ 4 \ \text{the re-} \\ \text{maining share.}$$

)	£		£
	150	$\times 6$	= 900
	200	$\times 3$	= 600
	125	$\times 16$	= 2000

	£	s.	d.
£3500	:	291	13 4 :: 900 :

$$840000d. \quad 70000d. \quad \times 900 \div 840000 \\ = 75l. \ \text{A's share.}$$

$$840000 : 70000 :: 600 : \times 70000 \div 840000 \\ = 50l. \ \text{B's share.}$$

$$\text{Ald } 291 \ 13 \ 4 - (75. + 50) = 166 \ 13 \ 4 \ \text{is C's} \\ \text{share.}$$



No.

ANSWERS.

(7) Y's gain was  $\frac{5}{7}$ . Then  $\frac{1}{2} : \frac{1}{7} :: 756\text{L.} \times 4 : 504$  = O's product, which being divided by his number of months, will give 168L. as his contribution. Y's share of the stock (£280) may be found in the same way.

(8) If 300L. arise from 240L. in 6 months, 600L. B's stock and profit will be found to arise from 400L. (B's stock) in 12 months.

Then 400 : 160 :: 200 (the profit on 400L. in 12 months): 80L. (the profit on 160L. in 12 months), and 80L. (the profit on a certain sum for 12 months): 100L. (the profit on the same sum for another time) :: 12 (the number of months in the one case) : 100  $\times$  12  $\div$  80 (the number of months in the other case) = 15 the number of months required to produce the difference between 160L. C's stock, and the 260L. which he received.

(9)  $\begin{array}{ccccccc} \text{£} & & \text{£} & & \text{£} & & \text{£} \\ 60 & + & 200 & + & 100 & = & 360 \end{array}$  the sum of the gain.

$\begin{array}{ccccccc} \text{£} & & \text{£} & & \text{£} & & \text{£} \\ 360 & : & 8640 & : : & 60 & : \times & 8640 \div 360 = 1440, \end{array}$  the product of A's stock and time.

$\begin{array}{ccccccc} \text{£} & & \text{£} & & \text{£} & & \text{£} \\ 360 & : & 8640 & : : & 200 & : \times & 8640 \div 360 = 4800, \end{array}$  the product of B's stock and time.

$\begin{array}{ccccccc} \text{£} & & \text{£} & & \text{£} & & \text{£} \\ 8640 & - & (1440 + 4800) & = & 2400, \end{array}$  the product of C's stock and time.

$\begin{array}{ccccccc} \text{£} & & \text{£} \\ 1440 \div 6 & = & 240, \text{ A's stock.} \\ 4800 \div 12 & = & 400, \text{ B's } & & \text{,,} \\ 2400 \div 15 & = & 160, \text{ C's } & & \text{,,} \end{array}$

## BARTER.

No.

ANSWER.

(1)

$\begin{array}{ccccccc} s. & & s. & d. & & s. & d. \\ 10 & : & 12 & 6 & : : & 14 & : ? \\ 120d. & & 150d. & & & & 14 \times 150 \div 120 = 17 & 6 \end{array}$

ANSWERS.

$$\begin{array}{c} s. \quad d. \quad \quad d. \quad \quad \quad s. \quad d. \\ 4 \quad : \quad 6 \quad : : \quad 3 \quad 2 \quad : \quad ? \quad 38 \times 6 \div 16 = 1 \quad 2\frac{1}{4} \\ \hline 6d. \quad \quad \quad 38d. \end{array}$$

$$\begin{array}{c} d. \quad \quad d. \quad \quad \quad d. \\ 12 \quad : : \quad 5 \quad : \quad ? \quad 12 \times 5 \div 8 = 7\frac{1}{2}, \text{ the profit} \\ \text{which should arise to him from } 12d. \text{ with 9 months' credit.} \end{array}$$

$$\begin{array}{c} o. \quad mo. \quad \quad d. \\ 6 \quad : : \quad 7\frac{1}{2} \quad : \quad ? \quad 7\frac{1}{2} \times 6 \div 9 = 5d., \text{ the profit} \\ \text{in 6 months.} \end{array}$$

$$\begin{array}{c} d. \quad d. \quad d. \\ 12 + 5 = 17, \text{ is the price he must charge.} \end{array}$$

$$\begin{array}{c} o. \quad mo. \quad \quad d. \quad \quad \quad d. \\ 6 \quad : : \quad 5 \quad : \quad ? \quad 6 \times 5 \div 9 = 3\frac{1}{3}, \text{ the profit which} \\ \text{should arise from } 8d. \text{ for 6 months.} \end{array}$$

$$\begin{array}{c} d. \quad d. \\ 17 + 3\frac{1}{3} = 11\frac{1}{3}, \text{ is the price I should charge, with 6} \\ \text{months' credit.} \end{array}$$

$$\begin{array}{c} d. \quad d. \quad d. \quad \quad \quad d. \\ 11\frac{1}{3} \quad : \quad 17 \quad : : \quad 8 \quad : \quad ? \quad 8 \times 17 \div 11\frac{1}{3} = 12 \text{ the first} \\ \text{t, which bears the same relation to } 17d. \text{ that } 11\frac{1}{3}d. \text{ does} \\ 3d. \end{array}$$

ALLIGATION MEDIAL.

ANSWER.

$$\begin{array}{r} s. \quad \quad s. \\ 14 \times 2 = 28 \\ 12 \times 1 = 12 \\ 9 + 9 = 18 \\ 8 \times 4 = 32 \\ \hline 9 \quad ) 90 \\ \hline 10s. \\ \hline \hline \end{array}$$

No.

ANSWER.

$$\begin{array}{r} (2) \quad d. \quad \quad d. \\ 9 \times 17 = 153 \\ 7\frac{1}{2} \times 14 = 105 \\ 9\frac{1}{2} \times 5 = 47\frac{1}{2} \\ 4\frac{1}{2} \times 21 = 94\frac{1}{2} \\ \hline 57 \quad ) 400 \\ \hline 737 \\ \hline \hline \end{array}$$

No.

ANSWER.

(3)

oz.		oz.
7	$\times 22 =$	154
12 $\frac{1}{2}$	$\times 21 =$	262 $\frac{1}{2}$
17	$\times 19 =$	323
<div style="display: flex; justify-content: space-between;"> <span>36<math>\frac{1}{2}</math></span> <span>36<math>\frac{1}{2}</math>) 739<math>\frac{1}{2}</math></span> </div>		
204 $\frac{2}{3}$		

## ALLIGATION ALTERNATE.

No.

ANSWERS.

(4)

s.	d.	d.	d.	s.	d.
8	6	—	4	—	2 + 9 0
				s.	d.
				4 galls.	@ 9 0
				2 „	@ 8 6

(5)

s.	d.	d.	d.	s.	d.
6	0	+	20	—	8 — 3 8
				lb	s.
				20	@ 3 8
				8	@ 6 0

No.

ANSWER.

(6)

d.	d.	d.	d.
5	—	5	— 2 + 12
7	—	3	— 3 + 13
		lb.	d.
		5	@ 12
		3	@ 13
		2	@ 5
		3	@ 7

(7)

s.	d.	d.	s.	d.
5	0	+	8	— 10 — 3 6

lbs.	s.	d.	lbs.	lbs.	lbs.	lbs.	s.
8	@	3 6	18	:	27 ::	8 :	
10	@	5 0					
<div style="display: flex; justify-content: space-between;"> <div> <math>\frac{8 \times 27}{18} = 12 @ 3</math> </div> <div> <math>\frac{10 \times 27}{18} = 15 @ 5</math> </div> </div>							

ANSWERS.

$$\begin{array}{r} d. \quad d. \quad d. \\ 4 - 3 - 1 + 8 \\ 6 - 1 - 1 + 8 \end{array}$$

$$\begin{array}{r} lb. \quad lbs. \quad d. \\ 3 + 1 = 4 @ 8 \\ \quad \quad 1 @ 4 \\ \quad \quad 1 @ 6 \end{array}$$

$$\begin{array}{r} \text{Total} \quad 6 \\ \hline \end{array}$$

$$\begin{array}{l} lbs. \quad lbs. \quad lbs. \quad : \quad \frac{4 \times 112}{6} = 74\frac{2}{3} @ 8 \\ 6 : 112 : : 4 : \\ 6 : 112 : : 1 : \quad \frac{112}{6} = 18\frac{2}{3} @ 4 \\ 6 : 112 : : 1 : \quad \frac{112}{6} = 18\frac{2}{3} @ 6 \end{array}$$

$$\begin{array}{r} s. \quad d. \quad d. \quad d. \quad s. \quad d. \quad gals. \quad s. \quad d. \\ 12 \quad 0 - 18 - 6 + 14 \quad 9 \quad 18 @ 14 \quad 0 \\ 18 \quad 0 - 6 - 12 + 14 \quad 6 \quad 6 @ 14 \quad 6 \\ \quad \quad \quad \quad \quad \quad \quad \quad 6 @ 12 \quad 0 \\ \quad \quad \quad \quad \quad \quad \quad \quad 12 @ 13 \quad 0 \end{array}$$

$$\begin{array}{r} \text{Total} \quad 42 \\ \hline \end{array}$$

$$\begin{array}{l} gals. \quad gals. \quad : : \quad 18 : ? \quad \frac{18 \times 63}{42} = 27 @ 14 \quad 0 \\ 42 : 63 : : 6 : ? \quad \frac{6 \times 63}{42} = 9 @ 14 \quad 6 \\ 42 : 63 : : 6 : ? \quad \frac{6 \times 63}{42} = 9 @ 12 \quad 0 \\ 42 : 63 : : 6 : ? \quad \frac{12 \times 63}{42} = 18 @ 13 \quad 0 \end{array}$$

No.

ANSWER

(10)

$$\begin{array}{cccccc} s. & d. & s. & s. & d. \\ 6 & + & 20 & - & 8 & - & 3 & 8 \end{array}$$

$$\begin{array}{ccc} \text{lbs.} & s. & d. \\ 20 & @ & 3 \quad 8 \\ 8 & @ & 6 \quad 0 \end{array} \left. \vphantom{\begin{array}{ccc} \text{lbs.} & s. & d. \\ 20 & @ & 3 \quad 8 \\ 8 & @ & 6 \quad 0 \end{array}} \right\} \text{ will make the required mixture.}$$

$$\begin{array}{ccccccc} \text{lbs.} & \text{lbs.} & \text{lbs.} & & \text{lbs.} & & \\ 20 & : & 12 & :: & 8 & : & \frac{8 \times 12}{20} 4\frac{2}{5} \end{array} \text{ the quantity at}$$

which corresponds to 12 lbs. at 3s. 8d.

## INVOLUTION.

No.

ANSWER.

(1)

$$\begin{array}{rcl} 2 & \text{1st power..} & \\ 3 & & \\ \hline 9 & \text{2nd} & \text{"} \\ 3 & & \\ \hline 27 & \text{3rd} & \text{"} \\ 3 & & \\ \hline 81 & \text{4th} & \text{"} \\ 3 & & \\ \hline 243 & \text{5th} & \text{"} \\ \hline \end{array}$$

## ANSWER.

20	1st	power.
20		
<hr/>		
400	2nd	"
20		
<hr/>		
8000	3rd	"
20		
<hr/>		
160000	4th	"
20		
<hr/>		
3200000	5th	"
20		
<hr/>		
64000000	6th	"
20		
<hr/>		
1280000000	7th	"
20		
<hr/>		
25600000000	8th	"
20		
<hr/>		
512000000000	9th	"
20		
<hr/>		
10240000000000	10th	"

Or thus—

3200000	5th	power.
3200000	5th	"
<hr/>		
640000000000		
960000000000		
<hr/>		
10240000000000	10th	"

130

## SECTION III.

No.

ANSWERS.

(3)

3 1st power.

3

9 2nd "

3

27 3rd "

27

729 6th "

3

2187 7th "

(4)

105 1st power.

105

11025 2nd "

105

1157625 3rd "

1157625 3rd "

1340095640625 6th "

(5)

1.05 1st power.

1.05

1.1025 2nd power.

1.05

1.157625 3rd power.

1.157625

6th power 1.340095640625

No.

ANSWERS.

$$(6) \quad \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} = \frac{16}{81}$$

$$(7) \quad \frac{3}{5} \times \frac{3}{5} \times \frac{3}{5} \times \frac{3}{5} \times \frac{3}{5} \times \frac{3}{5} \times \frac{3}{5} = \frac{2187}{78125}$$

$$(8) \quad \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} = \frac{2187}{16384}$$

$$(9) \quad \frac{5}{9} \times \frac{5}{9} \times \frac{5}{9} \times \frac{5}{9} \times \frac{5}{9} = \frac{3125}{59049}$$

$$(10) \quad 11\frac{2}{5} = \frac{57}{2}, \quad \frac{57}{5} \times \frac{57}{5} \times \frac{57}{5} = \frac{185193}{125}$$

$$(11) \quad 3\frac{2}{7} = \frac{23}{7}$$

$$\frac{23}{7} \times \frac{23}{7} \times \frac{23}{7} \times \frac{23}{7} \times \frac{23}{7} = \left(\frac{23}{7} \times \frac{23}{7}\right) \times$$

$$\left(\frac{23}{7} \times \frac{23}{7}\right) \times \frac{23}{7} = \frac{6436343}{16807}$$

$$(12) \quad 5\frac{8}{9} = 5\frac{8}{9}$$

$$\frac{58}{9} \times \frac{58}{9} \times \frac{58}{9} \times \frac{58}{9} \times \frac{58}{9} \times \frac{58}{9} = \left(\frac{58}{9} \times \frac{58}{9} \times \frac{58}{9}\right) \times \left(\frac{58}{9} \times \frac{58}{9} \times \frac{58}{9}\right) = \frac{22161361128}{581441}$$



No.

ANSWER.

(13)

$$4\frac{5}{7} = \frac{33}{7}$$

$$\begin{aligned} & \frac{33}{6} \times \frac{33}{7} \times \frac{33}{7} \times \frac{33}{7} \times \frac{33}{7} \times \frac{33}{7} \times \frac{33}{7} = \\ & \left( \frac{33}{7} \times \frac{33}{7} \times \frac{33}{7} \times \left( \frac{33}{7} \times \frac{33}{7} \times \frac{33}{7} \right) \right) \times \\ & \frac{33}{7} = \frac{42618442977}{823543} \end{aligned}$$

## EVOLUTION (Square Root).

No.

ANSWERS.

(14)

. . . root.

30976(176

1

27)209

189

346) 2076

2076

(15)

. . . root.

622521(789

49

148)1925

1184

1569)14121

14121

No.

ANSWERS.

(16)

. . . . root.

1234321(1111

1

21) 23

21

221)243

221

2221)2221

2221

(17)

. . . . root.

2052·09(45·3

16

85)452

425

903)2709

2709

No.  
(18)

ANSWERS.

$$\begin{array}{r}
 \text{root.} \\
 4795 \cdot 25731 (69 \cdot 247 + \\
 36 \\
 \hline
 129) 1195 \\
 \quad 1161 \\
 \hline
 1382) 3425 \\
 \quad 2764 \\
 \hline
 13844) 66173 \\
 \quad 55376 \\
 \hline
 138487) 1079710 \\
 \quad 969409 \\
 \hline
 \quad 110301 \\
 \hline
 \hline
 \end{array}$$

(19)

$$\begin{array}{r}
 \text{root.} \\
 24674 \cdot 1264 (157 \cdot 08 \\
 1 \\
 \hline
 25) 146 \\
 \quad 125 \\
 \hline
 307) 2174 \\
 \quad 2149 \\
 \hline
 31408) 251264 \\
 \quad 251264 \\
 \hline
 \hline
 \end{array}$$

(20)

$$\frac{49}{144} = \frac{\text{root. } 7}{12}$$

(21)

$$\frac{196}{1369} = \frac{\text{root. } 14}{37}$$

R 3

## EVOLUTION—(CUBE Root).

No.

ANSWERS.

(22)

. root.  
373248(72  
843

---

30248

$$\begin{array}{rcl} 7 \times 7 & = & 49 \times 300 = 14700 \\ 7 \times 2 & = & 14 \times 30 = 420 \\ 2 \times 2 & = & 4 \end{array}$$

$$15124 \times 2 = 30248$$


---

(23)

. . root.  
54872(38  
27

---

27872

$$\begin{array}{rcl} 3 \times 3 & = & 9 \times 300 = 2700 \\ 3 \times 8 & = & 24 \times 30 = 720 \\ 8 \times 8 & = & 64 \end{array}$$

$$3484 \times 8 = 27872$$


---

(24)

. . root.  
389017(73  
343

---

46017

$$\begin{array}{rcl} 7 \times 7 & = & 49 \times 300 = 14700 \\ 7 \times 3 & = & 21 \times 30 = 630 \\ 3 \times 3 & = & 9 \end{array}$$

$$15339 \times 3 = 46017$$


---

No.

ANSWERS.

25)

$$\begin{array}{r}
 \text{root.} \\
 1092727(103 \\
 1 \\
 \hline
 92727
 \end{array}$$

$$\begin{array}{rcl}
 10 \times 10 & = & 100 \times 300 = 30000 \\
 10 \times 3 & = & 30 \times 30 = 900 \\
 3 \times 3 & = & 9
 \end{array}$$

$$\begin{array}{r}
 80909 \times 3 = 92727 \\
 \hline
 \hline
 \end{array}$$

6)

$$\begin{array}{r}
 \text{root.} \\
 84604519(439 \\
 64 \\
 \hline
 20604
 \end{array}$$

$$\begin{array}{rcl}
 4 \times 4 & = & 16 \times 300 = 4800 \\
 4 \times 3 & = & 12 \times 30 = 360 \\
 3 \times 3 & = & 9
 \end{array}$$

$$\begin{array}{r}
 5169 \times 3 = 15507 \\
 \hline
 \hline
 \end{array}$$

$$5097519$$

$$\begin{array}{rcl}
 43 \times 43 \times 300 & = & 554700 \\
 43 \times 9 \times 30 & = & 11610 \\
 9 \times 9 & = & 81
 \end{array}$$

$$\begin{array}{r}
 566391 \times 9 = 5097519 \\
 \hline
 \hline
 \end{array}$$

No.

## ANSWERS.

(27)

$$\begin{array}{r} \text{root} \\ 52734 \cdot 375 (37 \cdot 5 \\ 27 \end{array}$$


---

 25734

$$3 \times 3 \times 300 = 2700$$

$$3 \times 7 \times 30 = 630$$

$$7 \times 7 = 49$$

---


$$3379 \times 7 = 23653$$

---

 2081375

$$37 \times 37 \times 300 = 410700$$

$$37 \times 5 \times 30 = 5550$$

$$5 \times 5 = 25$$

---


$$416275 \times 5 = 2081375$$


---

(28)

$$\begin{array}{r} 7834 \cdot 8748 (19 \cdot 86 + \\ 1 \\ 6834 \end{array}$$

$$1 \times 1 \times 300 = 300$$

$$1 \times 9 \times 30 = 270$$

$$9 \times 9 = 81$$

---


$$651 \times 9 = 5859$$

---

 975874

$$19 \times 19 \times 300 = 108300$$

$$19 \times 8 \times 30 = 4560$$

$$8 \times 8 = 64$$

---


$$112924 \times 8 = 903392$$

---

 72482800

$$198 \times 198 \times 300 = 11761200$$

$$198 \times 6 \times 30 = 35640$$

$$6 \times 6 = 36$$

---


$$11796876 \times 6 = 70781256$$

---

 1701544
 

---

10.

## ANSWERS.

29j

$$\begin{array}{r} \text{root} \\ .053157346(.376 \\ 27 \end{array}$$

---


$$26157$$

$$3 \times 3 \times 300 = 2700$$

$$3 \times 7 \times 30 = 630$$

$$7 \times 7 = 49$$

---


$$3379 \times 7 = 23653$$

---


$$2504376$$

$$37 \times 37 \times 300 = 410700$$

$$37 \times 6 \times 30 = 6660$$

$$36$$

---


$$417396 \times 6 = 2504376$$


---

30)

$$7)4000000$$


---

$$\begin{array}{r} \text{root.} \\ 571428(.829 + \\ 512 \end{array}$$

$$8 \times 8 \times 300 = 19200$$

$$8 \times 2 \times 30 = 480$$

$$2 \times 2 = 4$$

---


$$59428$$

---


$$19684 \times 2 = 39368$$

---


$$20060571$$

$$82 \times 82 \times 300 = 2017200$$

$$82 \times 9 \times 30 = 22140$$

$$9 \times 9 = 81$$

---


$$2039421 \times 9 = 18354789$$

---


$$1705782$$


---

No.

ANSWERS.

(31)

$$7\frac{1}{2} = 7 \cdot 200 \overset{\text{root.}}{(1 \cdot 93 + 1)}$$


---


$$6200$$

$$1 \times 1 \times 300 = 300$$

$$1 \times 9 \times 30 = 270$$

$$9 \times 9 = 81$$

---


$$651 \times 9 = 5859$$

---


$$641000$$

$$19 \times 19 \times 300 = 108300$$

$$19 \times 3 \times 30 = 1710$$

$$3 \times 3 = 9$$

---


$$110019 \times 3 = 330057$$

---


$$10943$$


---

## PROGRESSION.

(1)

$$7 \div 2 = 3.5$$

$$(3 + 15) \times 3.5 = 63.$$

(2)

$$49 \div 2 = 24.5$$

$$5 + 93 \times 24.5 = 2401.$$

(3)

$$\frac{3}{4} = 0.75 \quad .97 \div 2 = 48.5 \quad (147 + 0.75)$$

$$\times 48.5 = 7165.875.$$

(4)

$$(497 - 21) \div 40 = 11.9.$$

(5)

$$(127\frac{25}{28} - 9\frac{1}{7}) \div 25 = 4\frac{1}{2}.$$

(6)

$$(96 - 12) \div 6 = 14.$$

$$14 + 1 = 15.$$

(7)

$$(32 - 14) \div 3 = 6$$

$$6 + 1 = 7.$$

No.

ANSWERS.

$$(8) \quad \frac{512 \times 4 - 2}{4 - 1} = 682.$$

$$(9) \quad (1 + 24) \times \frac{24}{2} = 300.$$

$$(10) \quad (1s. + 9l. 19s.) \times \frac{100}{2} = 500l.$$

$$(11) \quad \begin{array}{rcl} 58 - 3 & = & 55 \\ 55 \div 5 & = & 11 \\ 11 + 1 & = & 12. \end{array}$$

$$(12) \quad \begin{array}{rcl} 32 - 4 & = & 28 \\ 28 \div 4 & = & 7 \\ 7 + 1 & = & 8. \end{array}$$

PROMISCUOUS EXERCISES.

$$(1) \quad \begin{array}{c} \text{a.} \quad \text{r.} \\ 186 \quad 3 \end{array} \times \frac{1}{9} = \frac{\begin{array}{c} \text{a.} \quad \text{r.} \\ 186 \quad 3 \end{array} \times 1}{9} = \begin{array}{c} \text{a.} \quad \text{r.} \\ 20 \quad 8. \end{array}$$

$$(2) \quad \begin{array}{c} \text{h.} \quad \text{m.} \\ 15 \quad 45 \end{array} \times \frac{4}{9} = \frac{\begin{array}{c} \text{h.} \quad \text{m.} \\ 15 \quad 45 \end{array} \times 4}{9} = 7 \text{ hours.}$$

$$(3) \quad \begin{array}{c} \text{cwt. qrs. lbs.} \\ 19 \quad 3 \quad 7 \end{array} \times \frac{870}{2219} = \frac{\begin{array}{c} \text{cwt. qrs. lbs.} \\ 19 \quad 3 \quad 7 \end{array} \times 870}{2219} = \begin{array}{c} \text{cwt. qrs. lbs.} \\ 7 \quad 3 \quad 2. \end{array}$$

$$(4) \quad \begin{array}{c} \text{ts. hhds} \quad \text{hhds.} \\ 4 \quad 3 \end{array} = 19, \text{ and } \begin{array}{c} \text{ts. hhds. hhds.} \\ 5 \quad 2 \end{array} = 22. \text{ Hence the re-} \\ \text{quired fraction is } \frac{19}{22} \text{ or } \frac{22}{19}.$$



No.

## ANSWERS.

$$(5) \quad \begin{array}{c} \text{£} \\ 2 \\ 3 \end{array} + \frac{5}{9} = \frac{2 \times 20}{3} + \frac{5}{9} = \frac{40}{3} + \frac{5}{9} = \frac{120}{9} + \frac{5}{9} = \frac{125}{9} = 13 \frac{5}{9} \text{ s. } d.$$

$$(6) \quad \frac{1}{3} + \frac{1}{10} + \frac{1}{8} + \frac{1}{6} = \frac{40}{120} + \frac{12}{120} + \frac{15}{120} + \frac{20}{120} = \frac{87}{120} = \frac{29}{40} \text{ is the quantity he gave away.}$$

$$\text{And } 1 \frac{29}{40} = \frac{40}{40} = \frac{29}{40} = \frac{11}{40}, \text{ the quantity he kept.}$$

$$(7) \quad \begin{array}{r} \text{£} \\ 0.86875 \\ \underline{20} \\ 17.37500 \text{ s.} \\ \underline{12} \\ 4.500 \text{ d.} \\ \underline{4} \\ 2.0 \text{ f.} \end{array} \quad \begin{array}{r} \text{s.} \quad \text{d.} \\ 17 \quad 4\frac{1}{2} \end{array}$$

$$(8) \quad \begin{array}{r} \text{£} \\ 0.5375 \\ \underline{20} \\ 10.7500 \text{ s.} \\ \underline{12} \\ 9.00 \text{ d.} \end{array} \quad \begin{array}{r} \text{s.} \quad \text{d.} \\ 10 \quad 9 \end{array}$$

No.  
(9)

ANSWERS.

$$\begin{array}{r}
 0.875 \\
 \underline{4} \\
 8.500 \text{ qrs.} \\
 \underline{4} \qquad \text{qrs. nls.} \\
 2.0 \text{ nls.} \\
 \underline{\underline{\hspace{1cm}}}
 \end{array}
 \begin{array}{r}
 \\
 \\
 3 \quad 2
 \end{array}$$

(10)

$$\begin{array}{r}
 \text{galls.} \\
 0.875 \\
 \underline{4} \\
 8.500 \text{ qts.} \\
 \underline{2} \\
 1.0 \qquad \text{qts. rt.} \\
 \underline{\underline{\hspace{1cm}}} \qquad 3 \quad 1
 \end{array}$$

(11)

$$\begin{array}{r}
 \text{days.} \\
 0.3945 \\
 \underline{24} \\
 9.4680 \text{ hrs.} \\
 \underline{60} \\
 28.080 \text{ min.} \\
 \underline{60} \\
 4.80 \text{ ''} \\
 \underline{60} \\
 48.00 \text{ '''} \\
 \underline{\underline{\hspace{1cm}}} \\
 \text{hrs. min. '' '''} \\
 9 \quad 28 \quad 4 \quad 48
 \end{array}$$

No.

ANSWERS.

(12)

0.09375 acre

4

0.37500 rood.

40

15.000 perch.

rood. perch.

0 15

(13)

$$\begin{array}{r} \pounds \\ 50 \times 2 = 100 \end{array}$$

$$40 \times 5 = 200$$

$$30 \times 7 = 210$$

$$\begin{array}{r} 120 \\ \hline \end{array}$$

$$\begin{array}{r} ) 510 \text{ (} 4\frac{1}{2} \text{ months.} \\ \underline{480} \end{array}$$

$$30 = \frac{1}{2}$$

(14)

$$\frac{1}{2} \times 3 = \frac{3}{2}$$

$$\frac{1}{3} \times 5 = \frac{5}{3}$$

$$\frac{1}{6} \times 6 = \frac{6}{6}$$

$$\begin{array}{r} 1 \\ \hline \end{array} \quad \frac{25}{8} = 4\frac{1}{8} \text{ months.}$$

(15)

$$\frac{100}{800} : \frac{104\frac{1}{8}}{839} :: \frac{\text{g. st. } 873 \text{ } 11 : ?}{17471 \text{ st.}}$$

$$17471 \times 839 \div 800 = 18322 \frac{\text{st. p. } 11\frac{1}{2}}{\text{guil. st. } 2 \text{ } 1}$$

(16)

$$\frac{104\frac{1}{8}}{835} : \frac{100}{800} :: \frac{\text{g. st. p. } 1186 \text{ } 4 \text{ } 8 \text{ p. } ?}{379592 \text{ p. } \times 800 \div}$$

$$835 = 363680\frac{1}{8} \text{ p., or } 11389 \text{ } 10\text{s. } 01\frac{1}{2} \text{ p.}$$

No.

ANSWERS.

(17) 
$$\begin{array}{rclcl} & & \text{dol.} & \text{c.} & \text{s.} & \text{d.} \\ 1d. & : & 2746 & 30 & : : & 4 \ 3\frac{1}{2} : ? \\ \hline 2hd. & & & & & 103hd. \end{array}$$
  

$$2746 \cdot 30 \times 103 \div 2 = 282868 \cdot 9 \text{ halfpence, or}$$
  

$$589l. \ 6s. \ 2\frac{1}{2}d.$$

(18) 
$$\begin{array}{rclcl} \text{£} & & \text{£} & \text{s.} & \text{d.} & & \text{s.} & \text{d.} \\ 1 & : & 199 & 11 & 10 & : : & 84 & 9 : ? \\ \hline 240d. & & 47902d. & & & & 417d. & \end{array}$$
  

$$47902 \times 417 \div 240 = 19975134, \text{ or } 2080 \ 15. \text{ guil. st.}$$

(19) 
$$\begin{array}{rclcl} \text{£} & & \text{£} & & \text{f.} & \text{c.} & & \\ 1 & : & 330 & : : & 23 \cdot 25 & : ? & 330 \times 23 \cdot 25 = \\ & & & & \text{f.} & \text{c.} & & \\ & & & & 7672 \cdot 50. & & & \end{array}$$

(20) 
$$\begin{array}{rclcl} d. & & \text{£} & \text{s.} & d. & & \text{p.} & & \\ 40\frac{1}{2} & : & 809 & 9 & 8 & : : & 1 & : ? & \text{p.} & \text{r.} & \text{m.} \\ \hline 163f. & & 777104f. & & & & \div 163 = 4767 & 4 & 2\frac{8}{163}. \end{array}$$

(21) 
$$\begin{array}{rclcl} \text{s.} & \text{d.} & & \text{£} & \text{s.} & d. & & \text{dol.} & & \\ 4 & 3\frac{1}{2} & : & 589 & 6 & 2\frac{1}{2} & : : & 1 & : ? & \text{dol.} & \text{ct.} \\ \hline 103hd. & & & 282869hd. & & & \times 1 \div 103 = 2773 \cdot 23. \end{array}$$

No.

## ANSWERS.

(22)

?	:	680 pi.
94 pi.	:	100 duc.
1 duc.	:	320 mar.
272 mar.	:	630 rees.
420 rees	:	50d.
18 $\frac{2}{3}$ d.	:	1f.
1f.	:	10 $\frac{1}{2}$ d.

$$\frac{680 \times 100 \times 320 \times 630 \times 50 \times 1 \times 10\frac{1}{2}}{94 \times 1 \times 272 \times 400 \times 18\frac{2}{3} \times 1} =$$

$$\frac{7197120000000}{190907738} = 37699\ 468d.$$

$$100 : 37699\ 468 :: \frac{1}{2} : \frac{37699\ 468}{100} \times \frac{1}{2} =$$

188·497 is the commission.

$$37699\ 468 - 188\ 497 = 37510\ 971$$

$$\begin{array}{l} \text{P.} \\ 1 : 680 : : 50 : 680 \times 50 = 34000. \end{array}$$

$$37510\ 971 = 680, \text{ by circular exchange.}$$

$$34000\ 0 = 680 \text{ by direct exchange.}$$

$$12)3510\ 971$$

$$2,0)29,2\ 7$$

£14 12 7 is the gain.

(23)	cwt.	qrs.	lbs.	s.	d.		£	s.	d.
	5	8	14	@ 36	4	per cwt. =	10	13	5 $\frac{1}{2}$
	Do.			@ 34	0	„ =	9	19	9

The gain is £0 13 8 $\frac{1}{2}$ 

(24)

$$\begin{array}{l} \text{s.} \quad \text{d.} \\ 17 \quad 6 : 27 \quad 6 : : 100 : ? \end{array}$$

$$\frac{100 \times 330}{210} = 157\frac{1}{3}$$

157 $\frac{1}{3}$  - 100 = 57 $\frac{1}{3}$ , is the gain per cent.

No.

ANSWERS.

$$(25) \quad \begin{array}{c} \text{£} \\ 100 \end{array} : \begin{array}{c} \text{£} \\ 85 \end{array} :: \begin{array}{c} \text{£} \text{ s.} \\ 4 \text{ } 16 \end{array} : \frac{\begin{array}{c} \text{£} \text{ s.} \\ 4 \text{ } 16 \end{array} \times 85}{100} =$$

$$\begin{array}{c} \text{£} \text{ s.} \text{ d.} \\ 4 \text{ } 1 \text{ } 7\frac{1}{2} \end{array}$$

$$(26) \quad \begin{array}{c} \text{£} \\ \frac{2}{3} \end{array} : \begin{array}{c} \text{£} \\ 100 \end{array} :: 2 : \frac{\begin{array}{c} \text{£} \\ 100 \end{array} \times 2}{3} = \begin{array}{c} \text{£} \text{ s.} \text{ d.} \\ 66 \text{ } 13 \text{ } 4 \end{array}$$

B's share; and 100*l.* — 66*l.* 13*s.* 4*d.* = 33*l.* 6*s.* 8*d.* is C's share.

$$(27) \quad \frac{\frac{1}{8}}{\frac{1}{4}} \quad 1 - (\frac{1}{8} + \frac{1}{4}) = \frac{5}{8}, \text{ D's share of the ship.}$$

$$\frac{\frac{1}{8}}{1} \quad \begin{array}{c} \text{£} \\ 900 \end{array} :: \frac{1}{8} : \frac{\begin{array}{c} \text{£} \\ 900 \end{array}}{8} = \begin{array}{c} \text{£} \text{ s.} \\ 112 \text{ } 10 \end{array}, \text{ B's share of the ship.}$$

$$1 : \begin{array}{c} \text{£} \\ 540 \end{array} :: \frac{1}{4} : \frac{\begin{array}{c} \text{£} \\ 540 \end{array}}{4} = \begin{array}{c} \text{£} \text{ s.} \\ 67 \text{ } 10 \end{array}, \text{ B's share of the insurance.}$$

$$\begin{array}{c} \text{£} \text{ s.} \\ 112 \text{ } 10 \end{array} - \begin{array}{c} \text{£} \text{ s.} \\ 67 \text{ } 10 \end{array} = \begin{array}{c} \text{£} \\ 45 \end{array}, \text{ is B's loss.}$$

$$1 : \begin{array}{c} \text{£} \\ 900 \end{array} :: \frac{1}{4} : \frac{\begin{array}{c} \text{£} \\ 900 \end{array}}{4} = \begin{array}{c} \text{£} \\ 225 \end{array}, \text{ C's share of the ship.}$$

$$1 : \begin{array}{c} \text{£} \\ 540 \end{array} :: \frac{1}{4} : \frac{\begin{array}{c} \text{£} \\ 540 \end{array}}{4} = \begin{array}{c} \text{£} \\ 135 \end{array}, \text{ C's share of the insurance.}$$

$$\begin{array}{c} \text{£} \\ 225 \end{array} - \begin{array}{c} \text{£} \\ 135 \end{array} = \begin{array}{c} \text{£} \\ 90 \end{array}, \text{ is C's loss.}$$

$$\begin{array}{c} \text{£} \\ 900 \end{array} - (\begin{array}{c} \text{£} \text{ s.} \\ 112 \text{ } 10 \end{array} + \begin{array}{c} \text{£} \\ 225 \end{array}) = \begin{array}{c} \text{£} \text{ s.} \\ 562 \text{ } 10 \end{array} \text{ D's share of the ship.}$$

$$\begin{array}{c} \text{£} \text{ s.} \\ 540 \end{array} - (\begin{array}{c} \text{£} \text{ s.} \\ 67 \text{ } 10 \end{array} + \begin{array}{c} \text{£} \text{ s.} \\ 135 \end{array}) = \begin{array}{c} \text{£} \text{ s.} \\ 337 \text{ } 10 \end{array}, \text{ D's share of the insurance.}$$

$$\begin{array}{c} \text{£} \text{ s.} \\ 562 \text{ } 10 \end{array} - \begin{array}{c} \text{£} \text{ s.} \\ 337 \text{ } 10 \end{array} = \begin{array}{c} \text{£} \\ 225 \end{array}, \text{ is D's loss}$$

No.

ANSWERS.

(28)  $\begin{array}{ccc} \text{£} & \text{£} & \text{£} \\ 150 & + & 260 = 410, \text{ the sum of B's and C's stocks.} \\ \text{£} & \text{£} & \text{£} \\ 62 & - & 16 = 46, \text{ the sum of their gain.} \end{array}$

$$\begin{array}{ccc} \text{£} & \text{£} & \text{£} \\ 46 & : & 410 : : 16 \end{array} . \quad \frac{16 \times 410}{46} = 142 \text{ } ^\text{s}.$$

D's stock.

$$\begin{array}{ccc} \text{£} & \text{s.} & \text{d.} \\ 150 & \cdot 0 & 0 \\ 260 & 0 & 0 \\ 142 & 12 & 2 \end{array}$$

$$\begin{array}{ccc} \text{£} & & \text{£} \\ 552 & 12 & 2 : 62 : : 150 : ? \end{array}$$

$132626d.$   $36000d. \times 62 \div 132626d.$ ; or  $16l. 6s. 7d.$ , B's share of the gain; and  $62l. - (16l. + 16l. 6s. 7d.) = 29l. 3s. 5d.$ , C's share of the gain.

(29)  $\begin{array}{ccc} \text{£} & & \text{£} \\ 4000 \times 12 & = & 48000 \\ 3000 \times 15 & = & 45000 \\ 5000 \times 9 & = & 40000 \end{array}$

$$\begin{array}{ccc} \text{£} & & \text{£} \\ 133000 & : & 665 : : 48000 : ? \end{array}$$

$$48000 \times 665 \div 133000 = 240l. \text{ B's share.}$$

$$133000 : 665 : : 45000l. : ?$$

$$45000 \times 665 \div 133000 = 225l. \text{ C's share.}$$

$$\text{And } 665 - (240 + 225) = 200, \text{ D's share.}$$

(30)  $\begin{array}{ccc} \text{£} & \text{s.} & \text{£} \text{ } \text{s.} \text{ } \text{d.} \\ 25 & 10 \times 5 & = 127 \text{ } 10 \text{ } 0 \\ 33 & 15 \times 10\frac{1}{2} & = 354 \text{ } 7 \text{ } 6 \end{array}$

$$\begin{array}{ccc} & & \text{£} \text{ } \text{s.} \text{ } \text{d.} \\ & & 481 \text{ } 17 \text{ } 6 \\ \text{Deuct} & & 150 \text{ } 1 \text{ } 6 \end{array}$$

$$\text{£}331 \text{ } 16 \text{ } 0 \text{ the remainder}$$

$$\begin{array}{ccc} \text{£} & \text{s.} & \text{s.} \\ 331 & 16 \div 21 & = 316 \text{ barrels} \end{array}$$

## ANSWERS.

$d. \quad d. \quad d. \quad 5 \times 12 = d.$   
 $8 : 12 :: 5 : \frac{5 \times 12}{8} = 7\frac{1}{2},$  the profit which  
 ld arise from 12*d.* for 9 months. But 5*d.* is the actual  
 mon.  
 it and  $7\frac{1}{2}d. : 5d. :: 9 \text{ mon.} : \frac{9 \times 5}{7\frac{1}{2}} = 6 \text{ months.}$

$d. \quad d. \quad d. \quad d.$   
 $5 - 6 \quad \text{---} \quad 1 + 12$   
 $10 - 1 \quad \text{---} \quad 5 + 16$   
 lbs.  $d. \text{ lb.} \quad d. \text{ lb.} \quad d. \quad \text{lb.} \quad d.$   
 6 @ 12, 1 @ 16, 1 @ 5, and 1 @ 10.

$s. \quad s. \quad s. \quad s.$   
 $5 - 2 \quad \text{---} \quad 1 + 8$   
 $6 - 1 \quad \text{---} \quad 2 + 9$   
 cwt.  
 $1\frac{1}{2} = 168 \text{ lbs.}$

$s. \quad s. \quad s. \quad s.$   
 $8 \quad 6 : 168 :: 2 : \frac{2 \times 168}{6} = 56 @ 8$   
 $9 \quad 6 : 168 :: 1 : \frac{168}{6} = 28 @ 9$   
 $5 \quad 6 : 168 :: 1 : \frac{168}{6} = 28 @ 5$   
 $6 \quad 6 : 168 :: 1 : \frac{2 \times 168}{6} = 56 @ 6$

18.

$d. \quad h. \quad h. \quad d.$   
 $14 + 4 \quad \text{---} \quad 8 - 10\frac{1}{2}$   
 $16 + 8$   
 $4 + 8 = 12 @ 10\frac{1}{2}$   
 $3 @ 14$   
 $3 @ 16$   
 $3 : 50 :: 12 : \frac{12 \times 50}{5} = 200 \text{ lbs. pewter.}$   
 $3 : 3 :: 50 : \frac{50 \times 3}{3} = 50 \text{ lbs. brass}$



(35.)

<i>s.</i>	<i>d.</i>		<i>d.</i>		<i>d.</i>		<i>s.</i>	<i>d.</i>
7	5	+	17	—	22	—	4	2
6	8	+	8	—	10	—	5	2

	<i>galls.</i>	<i>s.</i>	<i>d.</i>
17	@	4	2
8	@	5	2
22	@	7	5
10	@	6	8

$$\begin{aligned}
 10 : 20 :: 17 : \frac{17 \times 20}{10} &= 34 @ 4 \ 2 \\
 10 : 20 :: 8 : \frac{8 \times 20}{10} &= 16 @ 5 \ 2 \\
 10 : 20 :: 22 : \frac{22 \times 20}{10} &= 44 @ 7 \ 5
 \end{aligned}$$

(36)

$$\begin{array}{r}
 \begin{array}{c} \cdot \cdot \cdot \cdot \cdot \\ 22420225 \end{array} \begin{array}{c} \text{root.} \\ (4735 \end{array} \\
 \underline{16} \\
 87)642 \\
 \underline{609} \\
 943)3302 \\
 \underline{2829} \\
 9465)47325 \\
 \underline{47325} \\
 \hline
 \hline
 \end{array}$$

(37)

$$\begin{array}{r}
 \begin{array}{c} \cdot \cdot \cdot \cdot \cdot \\ 328329 \end{array} \begin{array}{c} \text{root.} \\ (573 \end{array} \\
 \underline{25} \\
 107)783 \\
 \underline{749} \\
 1113)3429 \\
 \underline{0429} \\
 \hline
 \hline
 \end{array}$$

PROMISCEOUS EXERCISES.

169

No.

(38)

ANSWERS.

root.  
91·9681(9·59  
81

185)1096  
925

1909)17181  
17181

(39)

root.  
179597069288(5642  
125

$$\left. \begin{array}{l} 300 \times 5^2 \times 6 \\ 80 \times 5 \times 6^2 \\ 6^2 \times 6 \end{array} \right\} = 50616$$

54597

$$\left. \begin{array}{l} 300 \times 56^2 \times 4 \\ 30 \times 56 \times 4^2 \\ 4^2 \times 4 \end{array} \right\} = 3790114$$

3981069

$$\left. \begin{array}{l} 100 \times 564^3 \times 2 \\ 30 \times 564 \times 2^2 \\ 2^2 \times 2 \end{array} \right\} = 190925288$$

190925288

No.

ANSWERS.

(40)

$$\begin{array}{r}
 \text{root.} \\
 83(8\cdot207534 \\
 3^3 = 27 \\
 300 \times 3^2 \times 9 = 5400 \\
 30 \times 3 \times 2^2 = 360 \\
 2 \times 2^2 = 8 \\
 \hline
 232000000 \\
 300 \times 320^2 \times 7 = 215040000 \\
 30 \times 320 \times 7^2 = 470400 \\
 7 \times 7^2 = 343 \\
 \hline
 215510743 \\
 16489257000 \\
 300 \times 3207^2 \times 5 = 15427273500 \\
 30 \times 3207 \times 5^2 = 2405250 \\
 5 \times 5^2 = 125 \\
 \hline
 15429678875 \\
 1059578125000 \\
 300 \times 32075^2 \times 3 = 925925062500 \\
 30 \times 32075 \times 3^2 = 8660250 \\
 3 \times 3^2 = 27 \\
 \hline
 925933722777 \\
 133644402223000 \\
 300 \times 320753^2 \times 4 = 123458984410800 \\
 30 \times 320753 \times 4^2 = 153961440 \\
 4 \times 4^2 = 64 \\
 \hline
 123459138372304 \\
 10185263850696
 \end{array}$$

$$(41) \quad 4\frac{3}{8} = 4\cdot375. \quad 42 \div 2 = 21.$$

$$(4\cdot375 + 143) \times 21 = 3094\cdot875.$$

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